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Estimation of relative abundance of recreationally important finfish in the Virginia portion of the Chesapeake Bay : annual progress report July 1998 - June 1999

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Project Number F104-R9
July 1998 - June 1999

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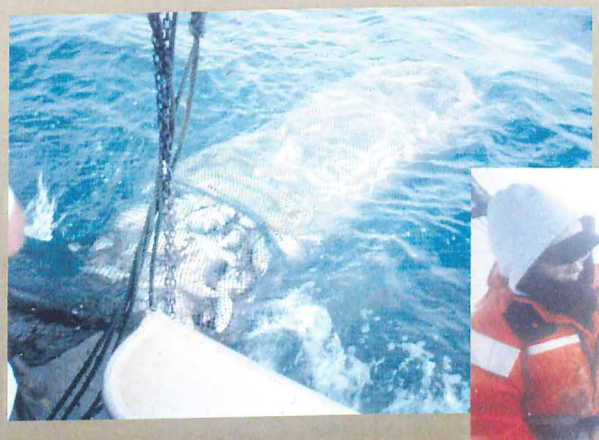

VIMS

U.S. Fish and Wildlife Service
Sportfish Restoration Project F104R9

Submitted to
Virginia Marine Resources Commission
United States Fish and Wildlife Service

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ANNUAL PROGRESS REPORT

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This project is supported by the U.S. Fish and Wildlife Service and the Virginia Marine Resources Commission through the Sportfish Restoration Program, Project F104R. Prior and supplementary field collections analyzed herein were supported by funding from the National Marine Fisheries Service through the Chesapeake Bay Stock Assessment Committee and by the Virginia Institute of Marine Science.

DISCLAIMER

Some of the results contained in this report have just recently been completed and may contain some errors and/or need further refinement. In particular, information pertaining to gear conversions and the longer time series they provide (1955-1998) should be used with some caution until further evaluation provides more concrete results.

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EXECUTIVE SUMMARY

Project Objectives

1 & 2: Several annual indices of juvenile abundance have been generated from trawl survey data for species of key recreational importance in the Virginia portion of Chesapeake Bay (spot, croaker, weakfish, summer flounder, black sea bass and striped bass, white and channel catfish) and four species of secondary importance (scup, white perch, northern puffer, and silver perch). No species has shown a continuous trend during the past twelve years under the present sampling scheme. However, several species have revealed declines (spot, scup, y-o-y white perch, northern puffer) or increases (Atlantic croaker and striped bass) in recent years. Spot has shown the largest decline from a high geometric mean catch per trawl of 68 (1988) to a low (1992) of 1.96, with the 1998 year class showing similarly low values (1.88). Atlantic croaker has the greatest variability between years, with the 1989 index of 65 being 4 to 7 times higher than that seen in the ten years since. The weakfish estimates have remained stable since 1995. Striped bass estimates for the 1998 year class were comparable to those observed from 1994-96 at 1.30 fish per trawl. Juvenile summer flounder remained low in 1998 as compared to the successful year classes of 1990, 91, and 94. Both black sea bass and scup juvenile recruitment to lower Chesapeake Bay which had been declining most of the 1990's, have shown slight improvement the past two years. The age 1+ values for the catfish species remained relatively stable while y-o-y estimates varies much more. Northern puffer has exhibited a near continuous downward trend since the start of the expanded survey in 1988. Silver perch are characterized by periods of very low abundance followed by several years of high catch rates.

3: Vessel and gear comparisons are now complete and results published (Hata, 1997). Conversions are being applied to data to produce a time series dating to 1955.

The results of these studies have been applied to historical data to provide a longer time series (1955 to present). Two additional indices have been created. A random stratified converted index (RSCI) using converted values in a post-stratified design, and a random stratified index (RSI) which does not adjust catches by gear and vessel. Both these indices use similar spatial and temporal components as originally reported with the Bay and river mid-channel transects indices (BRI), however, values are adjusted to the present sampling scheme, and in the case of the RSCI, adjusted for gear/vessel differences.
The application of these conversion values is still being debated, with concerns of statistical significance (measured as mean catch difference) versus significant positive correlations. Also of concern are missing spatial and/or temporal data which can skew results from these earlier surveys.

4: The random stratified sampling of the tributaries (James, York, and Rappahannock Rivers) has shown to be highly correlated with that of the mid-channel fixed station transects for many key species. In many cases, there are no significant differences in catch rates between

the two types of sampling.

5: Ageing of scup, butterfish, silver perch, and American eel is continuing. Preliminary results for American eel indicate age at length differences between water systems. Scup specimens captured by trawl surveys are almost exclusively less than 1.5 years in age.

6: Exploratory monitoring of some of the secondary water systems was established in July of 1998 with sampling performed on a quarterly basis. The Pocomoke Sound, Mobjack Bay, Piankatank and Great Wicomico Rivers are sampled each quarter using a random stratified design similar to the primary survey. Early results have shown higher catch rates of species such as summer flounder, spot, and silver perch on some of these systems as compared to the main-stem bay, James, York, and Rappahannock Rivers.

*: Analysis and summary of data continues to be routinely produced and available in the form of an annual data summary report. These summaries allow for detailed comparisons and contrasts of annual results with previous surveys. Efforts are underway to produce an Internet version of these reports.

*: Efforts are continuing to examine and evaluate older data sets for valuable and necessary information. Historical data are being analyzed and incorporated into data summary reports similar to those presented in recent years.

*: 1998 marks the first time since the expanded survey of the Bay was established (1988) that a monthly survey was not completed on schedule. In August 1998, the engine of the research platform, *Fish Hawk*, failed and could not be repaired in time to complete the survey. As a result the entire Chesapeake Bay and 8 stations on the upper Rappahannock River were not sampled. These missing data will affect the estimates of abundance for spring Atlantic croaker, northern puffer, scup, spot, and weakfish.

*: Since most of the species concerned are highly migratory and utilize widespread nursery areas, a multi-state effort will be required to fully evaluate their relative annual reproductive success.

*: Nomenclature used in the discussion of the various gears used throughout this report requires some clarification. To describe, in full, a particular gear each time it is mentioned would be lengthy, repetitive, and cumbersome. To refer to each gear by its VIMS gear code designation is meaningless without some convenient key. To deal with this concern, each gear has been provided a name which corresponds to its configuration. A series of characters will be applied, separated by an underscore, "_", to describe each gear. The characters are designated as follows:

Lined or Unlined _ Tickler chain or Not _ 20, 30, or 60 ft Bridle _ Door Type
Door Type: SW = Small Wooden otter boards, 48"x22"

LW = **L**arge **W**ooden otter boards, 54"x24"
CV = Metal **C**hina - **V** doors

16 ft gears have an additional two characters at the beginning indicating them as such.

As an example, L_T_6B_CV is the lined, with a tickler chain, 60 ft bridle and china-v doors gear presently used by the project (VIMS gear code 108).

These gear descriptions, VIMS codes, names, and there period of primary use, appear on Table 9 and Figure 2.

INTRODUCTION

Measures of juvenile abundance are presently in wide use as a key element in the management of the Atlantic States' coastal fishery resources. Estimates of the relative interannual abundance of early juveniles (age-0) generated from scientific (fishery-independent) survey programs have been found to provide a reliable and early estimator of future year class strength (Goodyear 1985, Lipcius and Van Engel 1990). After a review of previously available indices of juvenile abundance for important fishery resource species in the Chesapeake Bay, the Chesapeake Bay Stock Assessment Committee (CBSAC), a federal/state committee sponsored and funded by the National Oceanic and Atmospheric Administration (NOAA), recommended that " a unified, consistent trawl program should be one of the primary monitoring tools for finfish and crab stock assessment." (Chesapeake Bay Program Stock Assessment Plan, Chesapeake Executive Council 1988). In order to facilitate the implementation of such a program, CBSAC directly supported pilot studies directed at developing a comprehensive trawl survey for Chesapeake Bay. In the Virginia portion of the bay the primary focus of this support was the initiation in 1988 of a monthly trawl survey of the main stem portion of the lower Bay. This survey served to compliment and greatly expand the monthly trawl surveys of the major Virginia tributaries (James, York and Rappahannock rivers) which have been conducted by the Virginia Institute of Marine Science (VIMS) as part of a long-term effort to monitor and assess the condition of fishery stocks in the lower Chesapeake Bay and its tributaries. The primary intent of the present project is to assure that this sampling effort be continued on a long-term basis as well.

The present sampling program (bay and tributaries) is a particularly vital component to insure that data will be of sufficient geographic resolution for the generation of annual relative estimates

of recruitment success of recreationally important finfish species of Chesapeake Bay. An analysis of the Virginia portion of the National Marine Fisheries Service (NMFS) Marine Recreational Fisheries Statistics Survey (MRFSS), revealed 1998 Virginia marine recreational catches to be dominated by croaker, spot, summer flounder, black sea bass, weakfish, striped bass, bluefish, pigfish, and kingfish, constituting 92.5% of the total estimated catch by numbers caught, and 87.6% by weight landed. All of these species depend upon the lower Chesapeake Bay and its tributaries as a nursery area, with all but bluefish highly vulnerable to bottom trawls (Table 1) (Anon. 1999). In addition to the key species cited above, past survey results indicate other species of recreational interest, including scup, white perch, silver perch, white and channel catfish, and others, are taken with sufficient regularity during trawling operations as to provide data sets suitable for the generation of useful indices of juvenile abundance.

The project also seeks to facilitate the further development of a comprehensive trawl survey program through gear evaluations and comparison studies which will serve to unify current trawling efforts while maximizing continuity with historical data sets (1955 to present). Although the primary focus of the project is the generation of annual indices of juvenile (young-of-year) abundance of recreationally and ecologically important marine and estuarine finfish, survey results can also be used to address other aspects of the population biology of these species, such as habitat utilization, early growth and survival, climate and pollutant interactions, or prevalence of disease.

The development of juvenile indices requires considerable continuous time series of data in order to determine the proper area-time sequences best used in index calculations. In view of this fact, Colvocoresses and Geer (1991) developed provisional annual juvenile abundance indices for spot, weakfish, Atlantic croaker, summer flounder, and black sea bass. In 1992, a provisional index

was developed for a sixth species, scup (Colvocoresses et al., 1992), with white perch and striped bass estimates developed the following year (Geer et al., 1994). Results for five additional species (white and channel catfish, silver perch, northern puffer, and tautog), were briefly introduced in the 1994 project report (Geer and Austin, 1994). However these results for tautog were extremely conditional due to the sporadic catch rates. Recent project reports, (Geer et al., 1995; Geer and Austin, 1996a), provided more concrete results for the species of interest, with the 1997 report (Geer and Austin, 1997) providing a time series back to 1955 with the use of gear conversions and post stratification methods.

Many of the above species are captured in significant numbers across several year classes. As a result, both y-o-y and age 1+ indices have been created for white perch, and white and channel catfish, with a recruit, or spring index (returning young-of-the-year) for Atlantic croaker. Preliminary estimates of abundance have been prepared for an additional 16 species of interest (Bonzek et al., 1995). However, presentation of these indices and those of other species will not be included in these reports without further literature reviews and additional analyses. The provisional nature of the reported values is emphasized by the fact that all of the abundance estimates for the initial five species reported during previous segments have undergone some minor modifications since their first publication.

The present report continues an attempt to relate the juvenile indices developed herein with a longer time series based on the traditional mid-channel transect tributary sampling. In some cases this appears to provide a historical context in which to place recent project results, while in others it only emphasizes the need for the present comprehensive sampling program. Overall data summaries for samples collected in the main stem bay sampling in 1988 (Chittenden, 1989) and for

both the bay and river sampling in 1988 (Land et al., 1994), 1989 (Geer et al., 1990), 1990 to 1992 (Bonzek et al., 1991, 1992, 1993) , 1993 (Geer et al., 1994), 1994 (Land et al., 1995), 1995 (Geer and Austin, 1996b) , 1996 (Geer et al., 1997) , 1997 (Geer, 1998) and 1998 (Geer, 1999) have been previously prepared and distributed.

METHODS

Field Sampling

Sampling protocol continues as described in previous segment reports and the above mentioned data summary reports. The gear remains a lined 30' (9.14m) semi-balloon otter trawl, 1.5" (38.1mm) stretched mesh and 0.25" (6.35mm) cod liner, and is towed along the bottom for a period of five minutes during daylight hours. Details of sampling protocols, gear specifications and specific collection information have been summarized in the reports for previous segments and the data report series cited above. In addition to the previous protocol, a new type of data were collected, beginning in May 1998, to describe the habitat or substrate type. Various substrates such as shell, sponge, hydroid, and sea squirts, may influence fish distribution and abundance. Many of these substrates extend up from the bottom into the water column creating a three dimensional structure which may be used for spawning, shelter, or feeding grounds. These substrates are measured discretely at each trawling site, based upon the quantity observed in the net (and attached to the tickler chain) in relationship to a standard container device. The goal is to map each substrate type and compare catch rates of various fish species in relationship to substrate distribution. Table 2 indicates the various substrates described to date and the discrete values used in estimating quantity.

Sampling of the near-shore shallow waters (4-12ft) of the eastern and western Bay (June 1995), and introduction of random stratified sampling of both the Rappahannock and James Rivers (September 1995, and March 1996, respectively) continued, and is now fully incorporated into the sampling scheme. This work was established in addition to, not at the expense of, the previous sampling design. Sampling remains on a monthly basis, (with the exception of the bay during January to March when few target species are available and only a single cruise has been conducted since 1991). The tributaries continue to be sampled with both the random stratified stations as well as the historical fixed mid-channel station transects. The stratification system is based on depth and latitudinal regions in the bay, or depth and longitudinal regions in the rivers. Each Bay region is 15 latitudinal miles and consists of six strata; western shore shallow (4-12ft), western shoal (12-30ft), central plain (30-42ft), deep channel ($\geq$ 42ft), eastern shoal, and eastern shore shallow (Table 3). Each tributary is divided into four regions of approximately ten longitudinal miles, with four depth strata in each - (4-12ft, 12-30ft, 30-42ft, and $\geq$ 42ft) (Tables 4 - 6, Figure 1). Strata are collapsed in areas where certain depths are limited. The fixed stations have been assigned a stratum according to their location and depth.

A proposal was put forth this project segment to provide exploratory monitoring of secondary water systems. Beginning in July of 1998, quarterly sampling of the Pocomoke Sound, Mobjack Bay, Piankatank and Great Wicomico Rivers was initiated. Each system was sampled once per quarter, usually with one system sampled per month (Piankatank and Great Wicomico Rivers are sampled the same month). The sampling order was randomly selected the first quarter, then altered by one month each proceeding quarter. This provided sampling every other month for each system, (excepted during one quarter where there is a four month separation). This method insures that over

a three year period, each system will be sampled during each month. Information from this sampling will further enhance knowledge of distribution, abundance, and essential fish habitat for Chesapeake Bay fishes.

Sampling methodology is identical to the primary survey with a random stratified survey design based on depth. Three of the four systems (Pocomoke, Mobjack, and Piankatank River) have been sampled by the program in the past. By reviewing the available information on these systems, several fixed sites were established to aid in comparison with past results. These fixed sites were assigned a stratum based on location and depth. Table 7 provides the sampling scheme for these systems.

With the exception of the fixed river stations, trawling sites within strata are selected randomly from the National Ocean Service's Chesapeake Bay bathymetric grid, a data base containing depth records measured or calculated at 15 cartographic second intervals. Two to four trawling sites are randomly selected for each bay strata per month, the number chosen varying seasonally according to observed changes in distribution, with sampling intensity being highest in the most heavily utilized strata. Exceptions include the shallow water strata where one to two stations have been occupied for each month's survey. There are one to two stations selected monthly for each river strata. The number of potential sites for the RSD of the bay and tributaries with the approximate areas of each strata, are given in Tables 3 -7. The RSD of the York River which began in June 1991, has been altered slightly to make depth strata similar to that of the James, Rappahannock, and main stem bay. In earlier segment reports (Geer et al., 1994), the proposed depth strata for the tributaries included all depths $\geq$ 30 ft as one strata. This was modified beginning January 1996, to create depth strata similar to the bay, (30-42ft and $\geq$ 42ft) (Geer and Austin 1996a).

Since these random stratified data of the tributaries were considered conditional until all three tributaries were being sampled (March 1996), previous samples will be assigned to the appropriated strata established January 1996.

Past reports have showed results dating back to only 1979. This was due mainly to gear and sampling changes which made earlier data difficult to use in the present sampling format. However, with gear and vessel conversions now available for most target species, these conversions can be used to provide a standard measure of relative abundance. In addition, station data have been post-stratified to the present sampling scheme, allowing for full use of the historical data. Although the stratification of the main-stem bay has not changed, that of the initial random stratified surveys of the rivers has. Furthermore, until now, these recent random surveys of the rivers have not been used in estimates of abundance. Previously only the historical fixed station transects have been used in estimating abundance, by post-stratifying rivers into two equal regions (Table 9). The bay latitudinal strata were slightly different, and overall coverage greater during the first year's (1988) sampling, but for the purpose of juvenile index calculations 1988 data were post-stratified into, and restricted to, those strata which have been continually sampled (1-12).

The fixed channel sites on the tributaries are spaced at approximately 5 mile intervals from the river mouths up to approximately the fresh water interface in each system. These stations have been sampled on a monthly basis almost continuously since 1980 (Table 9, Fig.2). They were previously sampled with monthly surveys using an unlined 30' trawl (Gear U_N_3B_SW, gear code 010) beginning in the mid-1950's (York R.) or early-1960's (James and Rappahannock) through 1972. During 1973-79, semi-annual random stratified sampling was performed by the Ichthyology Department while the Crustaceology Department continued the fixed tributary stations on a limited

monthly basis, (May - November). Areal weightings for the tributaries have been previously assigned by dividing each river into two approximately equal length "strata" and assuming that the stations in each strata are representative of the channel areas in those reaches (Table 8). These strata have been described in earlier segment reports. With all three tributaries now being sampled with a random stratified design, these fixed locations have been assigned to a stratum based on location and depth. The new combined tributary survey (fixed and random stations) will provide for a statistically sound survey, large spatial coverage, and a long term historical reference.

Gear Calibration Studies

Gear calibration analyses were completed in 1997 (Hata, 1997). Emphasis has been placed on applying these conversion values to the historical datasets and providing a converted catch for each observation. The methods and statistical analyses used for these calibration studies were fully explained in Hata (1997). This project segment's efforts involved applying these conversions to the historical data and creating permanent datasets.

Juvenile Index Computations

Measuring the abundance of migratory species (as are many of the key target species in this project) presents special difficulties, particularly if the timing and duration of migratory behavior is not constant from year to year. Juvenile fishes which use estuarine nursery areas are especially vulnerable to the vagaries of climate, as many rely upon climatically dependent wind driven and tidal circulation patterns for semi-passive transport into the estuaries as larvae and early juveniles, and later key their outward migration from the nursery areas on such annually variable environmental cues as temperature changes. Ideally the abundance of a juvenile finfish population should be

measured at that point when it is most fully recruited to the nursery area being monitored. However, in practicality this can only be accomplished if the time of maximal abundance and size of recruitment to the gear can be predicted (and surveys timed accordingly), or surveys can be conducted on such an intense periodicity over the season of potential maximal abundance as to be certain of reasonable temporal coincidence. Neither of these two approaches is possible in the present case. The period of recruitable maximal abundance and the scope of the area being surveyed has proven to be variable between years within species. This, coupled with the multi-specific monitoring objectives precludes temporally intense surveys in the face of finite resources. Given the multi-species nature of this program, it would be difficult to adjust survey timing in order to maximize the usefulness of the data collected for all species. Given this, the survey will continue to be conducted on a regular periodicity and juvenile indices constructed as best possible from these data.

In the previous and present reports the following approach was used for juvenile index calculation. Trawl catches of target species were first separated into young-of-year and older components by applying a standard monthly cutoff value to the length frequency information collected with each catch. Cutoff values vary among months for each species and were based on modal analyses of historical composite monthly length frequency data and reviews of ageing studies for each species (Colvocoresses and Geer, 1991). For the earlier months of the biological year cutoff values are usually arbitrary values which fall in between completely discrete modal size ranges. In the later part of the biological year, when early spawned, rapidly growing individuals of the most recent year class may overtake late spawned and slowly growing individuals of the previous year class, cutoff values are selected so as to preserve the correct numeric proportionality between year

classes despite the misclassification of individuals (Table 10). The extent of the zone of overlapping lengths and the proportion within that range attributable to each year class is estimated based on the shapes of each modal curve during the months prior to overlap occurring. A length value is then selected from within that range which will result in the appropriate proportional separation. Although this process involves considerable subjectivity and ignores possible interannual variability in average growth rates, there is little likelihood that any significant error will be introduced, as only a very small fraction of the total number of young-of-the-year individuals fall within the zone of overlap and most of the data used to construct juvenile indices is drawn from months when no overlap at all is present.

After partitioning out non-young-of-the-year individuals, monthly catch rates of the target species are map-plotted and strata-specific abundances and occurrence rates calculated. Numbers of individuals caught are logrithmetically transformed (ln(n+1)) prior to abundance calculations, as this transformation has repeatedly been shown to best normalize collection data for contagiously distributed organisms such as fishes (Taylor, 1953) and has been verified as the best suited transformation for Chesapeake Bay trawl collections (Chittenden, 1991). Resultant average catch rates (and the 95% confidence intervals as estimated by $\pm$ 2 standard errors) are then back-transformed to the geometric means. Coefficient of variation is expressed as the log transformed mean catch, EY_{st} divided by the standard deviation, EY_{st} / STD (Cochran, 1977). Plots and data matrices are then examined for the area-time combinations which appear to provide the best basis for juvenile index calculations. Criteria applied during the selection process include identification of maximal abundance levels, uniformity of distribution, minimization of overall variance, and avoidance of periods which indicated distribution patterns suggesting migratory behavior was

occurring. Although identification of areas most suitable for index calculations (primary nursery zones) is generally clear, selection of appropriate time windows has proven a more complex issue. Surveys are timed on regular period intervals which might or might not coincide with periods of maximal recruitment to the nursery areas. Using a very limited portion of the overall data set would decrease sample sizes, increasing both confidence intervals, and the risk of sampling artifacts influencing results. As a result, the use of a single (maximal) month's survey results was deemed inappropriate. Conversely, a conscious effort is made not to incorporate any longer temporal series of data into index calculations than is necessary in order to capture the period of maximal juvenile utilization of the nursery area. It is believed indices calculated over longer time periods run the risk of confounding temporal persistence on the nursery area with maximal utilization levels. Using this approach it has been possible to identify three or four month periods which consistently capture the months of highest abundance for the species thus far examined (Table 10).

After area-time combinations are selected, annual juvenile indices are calculated as the weighted geometric mean catch per tow. Strata-specific means and variances are calculated and then combined, weighing by stratum areas according to the formulae supplied by Cochran (1977). Since stratum areas are quite variable, use of a weighted mean will provide an index that more closely mirrors actual population sizes than will a simple mean.

For consistency purposes, several indices have been produced for each species: the original index which is based on the present bay strata and the fixed mid-channel tributary stations (Bay & River Index - BRI, 1979 to present); a post-stratified gear and/or vessel converted index using all spatially appropriate data (Random Stratified Converted Index - RSCI, 1955 to present); and an unconverted post-stratified index, also based on all spatially appropriate data (Random Stratified

Index - RSI, 1955 to present). These multiple indices are presented since results from the longer time series must be considered provisional, with concerns of missing data and conversion factors still being addressed.

RESULTS

The largest concern of the past project segment was the engine failure of the R/V *Fish Hawk*, which caused the program to not complete a monthly survey for the first time since the expanded sampling began in 1988. The vessel's engine failed on August 11th, and could not be repaired in time to complete the August sampling. As a result, the entire main-stem bay, and 8 stations in the upper portion of the Rappahannock River were not sampled. When it became evident the *Fish Hawk* would not be repaired by month's end, a decision was made to cancel the remainder of the August survey in lieu of using a vessel with unknown fishing power which would require lengthy vessel comparisons. In regards to the effect on the estimates of juvenile abundance, five of the species presented here use August as part of the temporal component in abundance estimates (spring croaker, northern puffer, scup, spot, and weakfish) (Table 10). The effects of these missing data will not be realized until system specific indices are created to evaluate the importance of each water system's contribution to the overall estimate.

Objectives 1 & 2: *To develop and produce timely annual estimates of recruitment success of important finfish species for the major Virginia nursery areas of Chesapeake Bay.*

Spot (*Leiostomus xanthurus*) - Spot has often been the most abundant of the recreational species caught by the survey, however in recent years their numbers have declined. Their distribution remains wide and consistent throughout the sampling area (Appendix Fig. 1). Juveniles first recruit to the gear in April, so for the purposes of year class index calculation this month was

taken as the beginning of the biological year. Typically, the period of July through October has captured the peak period of abundance for most years of the survey. Since during this temporal period spot were strongly distributed throughout the survey area (Appendix Fig. 1), all strata have been included in the calculations.

The weighted geometric mean catch per tow for juvenile spot has declined sharply in recent years. The tributary based index has averaged 23.3 since 1979, however, from 1991 to 1996 values have been far below that value, with results for 1998 declining dramatically from 1997 to just 3.04 fish per trawl. (Table 11, Fig. 3). Since 1988, the BRI and the Rivers only index have been quite similar, indicating comparable use of the main-stem bay and tributaries as nursery grounds.

Atlantic Croaker (*Micropogonias undulatus*). Croaker, like the spot, display high levels of abundance in the trawl catches but present a much more complex pattern of recruitment and distribution. Spawning takes place over a more protracted period than the other species considered here, and small early juveniles (<30mm) have been found to be present in the catches year-round (Norcross, 1983; Colvocoresses and Geer, 1991; Colvocoresses et al., 1992; Geer et al., 1994; Geer et al., 1995; Land et al., 1995). During some years, peak abundance occurs in the fall with animals less than 100mm, but in other years the peak occurs the following spring from animals either overwintering or recruiting from offshore waters. For the purposes of separating size cohorts on an annual basis, September was chosen as the most appropriate month to designate as the first month of 'new' recruitment. The months of October through December were the three months of highest juvenile abundance during many years and the vast majority of juveniles captured were taken during this season. The anomalous pattern of peak abundance

in the spring may be explained by length frequencies which shows these spring peaks were the result of returning individuals from the previous year class and not a new cohort of early juveniles. Recent ageing studies supports this theory, indicating these spring recruits are late y-o-y individuals which will soon be laying down an annulus (Barbieri et al., 1994; Barbieri, 1993). As a result of this anomaly and the fact these small juveniles in the fall are highly susceptible to winter mortality (Norcross, 1983), two indices were produced; A fall index of small individuals based on the months October to December, only in the rivers, and a spring (or recruit) index during the months of May to August with the entire sampling area as the spatial component (Appendix Fig. 2).

Successful spawning events are evident from the very successful year classes in the fall of 1984, 1985, and 1989. However, these successful spawning events often did not result in comparably successful recruitment the following spring (Table 12 and Figure 3). There appears to be no significant correlation between the fall and spring indices. Estimates for the fall index rose from 10.41 in 1997 to 21.26 in 1998, while the spring index declined in 1998 (0.48). Early observations suggest the recruitment during the spring of 1999 to be very successful.

Weakfish (*Cynoscion regalis*) - Weakfish, while considerably less abundant than the spot and croaker, are still one of the dominant species of the trawl collections. Juveniles occasionally have first occurred in the catches as early as late May and June, with June taken as the beginning of the biological year, but most new recruitment to the nursery areas has taken place in July, August and September. July young-of-the-year weakfish were found primarily in the tributaries, and by August and into the fall months had dispersed into the main stem Bay as well (Appendix Fig. 3). The three months of highest juvenile abundances were typically observed during the same

three month period, August-October.

The river only index has been relatively stable since 1994 with a mean of 10.05. The 1998 index for the rivers only was slightly below that average at 9.95 (Table 13, Figure 3). However, the bay-river index has been indicating an upward trend since a low in 1994 (2.67), with 1998 results at 8.18 fish per trawl (Table 13 and Figure 3).

Summer Flounder (*Paralichthys dentatus*) - Flounder are generally taken in lower numbers than the three sciaenid species but are still a regularly occurring component of the trawl catches. Small juveniles can first appear in the catches as early as late March, which for the current purposes is used as the beginning of the biological year; but in most years were not taken in appreciable numbers until June (Appendix Figure 4). Young-of-the-year summer flounder abundance continued to increase steadily throughout the summer and early fall towards a late fall peak, and then show clear evidence of emigration during December. As was the case with weakfish, a single three month period, September to November, encompassed the three months of greatest abundance for most years. During this time period juvenile flounder are broadly distributed across the main stem bay and are commonly taken in the lower rivers, but only rarely appear in catches in the upper tributaries. Index calculations therefore include all bay strata and the lower river strata.

The river index for 1998 was the lowest value since 1979, at 0.17 (Table 14, Figure 3). However, catches from the main-stem were strong, indicating values slightly lower than the past two years (1998 = 0.78). The near absence of juveniles in the channel areas of the tributaries has not been seen before. Values for the tributaries are often lower (or comparable) to those of the bay and river combined. However, the 1998 river index was only 22% of the river and bay

index. During the past ten years it has averaged 77%.

Black Sea Bass (*Centropristis striata*) - Like summer flounder, black sea bass are seldom taken in large numbers but regularly occur in the catches. Juveniles first appear in low numbers in August, which is used as the initial month for year class separation. When present, young-of-the-year sea bass occur throughout the bay strata but do not appear to penetrate into most of the tributaries on a regular basis except the lower James River, a pattern which held in 1998 (Appendix Figure 5). Index calculations have thus been based on all bay strata and the lower James stratum. Although some early juveniles appear in the bay during their first summer and fall and then emigrate out with the onset of winter, a much larger number of young-of-the-year enter the estuary during the following spring. During some years there is virtually no recruitment to the Chesapeake Bay by early juveniles spawned the same calendar year. Since abundances are higher and distribution much more consistent during the following late spring and early summer, juvenile index calculations have been based on the months of May through July. This period usually encompasses the three months of highest abundance. Since this index is calculated from the middle portion of the calendar year but the very end of the biological year, the resultant index is for the year class spawned the previous calendar year, i.e. the 1988 index is for the 1987 year class.

The annual juvenile indices for black sea bass have shown no consistent pattern (Figure 4). However, the river only index has shown a downward trend the past 6 years. Since the lower James River is often the extent of its distribution into the tributaries (and sample sizes are relatively small), this index may merely indicate years of increased recruitment. The Bay and river index ranges from 0.22 (1992 year class) to 2.36 (1989 year class). Results from 1999 are

not yet complete, but early indicators suggest a better than average year. (Table 15, Figure 4).

Scup (*Stenotomus chrysops*) - The scup is a primarily marine and summer spawning species and appears to use the Chesapeake Bay in much the same way as black sea bass; i.e. there is minimal usage of the estuary as a nursery area by early juveniles but a very significant use by older juveniles during their second summer. Early juvenile scup (25-40mm FL) occasionally appear in the catches in June, but rapidly disappear after that if they do indeed appear at all. Older scup first appear in the catches in May, and by June range in size from 50 to 215 mm. The original length cutoff criteria were based on ageing studies reported by Morse (1978), with the collective trawl data indicating three size classes which were assigned as the age-0, age-1 and age-2+ year classes. Since the age-0 component is annually variable and not persistent, and the largest size class is only taken in very small numbers, index calculations are performed on age-1 individuals. This component clearly remains present in the bay and available to the gear for the remainder of the summer and early fall. Thus, while the data collected are obviously not amenable to the construction of a true young-of-the-year juvenile index, it is suitable for assessing juvenile scup abundance just as they enter their second year. The term, "age 1" scup was often applied in earlier reports, when in actuality data were lagged one year (year - 1), referring to y-o-y measured in their second year. Although there has been some discussion whether the animals captured in Chesapeake Bay are young-of-the year or early age one, based on studies along the Virginia coast, trawl catches in these size ranges are comprised of mainly age one specimens (Campbell et al., unpublished manuscript).

Distributional data for 1998 and early 1999 (Appendix Figure 6) supports previous findings that the early age-1 nursery area is largely restricted to the two lower main stem bay segments,

although some large catches were associated with the upper bay in 1994 (Geer et al., 1995). Catch rates for scup usually peak in July, and essentially show a July-August dome. With the exception of 1988, when age-1 scup were not taken until July, there were also sizable numbers of late juveniles taken during the months of June and September. These months were therefore chosen as the temporal basis for index calculation.

Scup appear have been on the decline in Chesapeake Bay with values recorded for the 1996 year class at a 10 year low (Table 16, Fig. 4). Estimates for the 1997 year class further improved (0.50) with early observations from the 1999 sampling season indicating continued improvement.

Striped Bass -(*Morone saxatilis*) - Striped bass utilize the upper tributaries for spawning and nursery grounds, spawning from early to mid-April through the end of May, in tidal freshwater areas just above the salt wedge. Young-of-the-year striped bass often appear in catches in May to July in size classes less than 50 mm, but then diminish in abundance until the following winter. A second, stronger, and more consistent period of abundance occurs in December and continues through to February the following year in the upper regions of the rivers (Appendix Figure - 7).

After a very successful year class in 1993 (3.30), young of year striped bass declined the next four years, reaching values similar to the early 1980's at 0.41 in 1997 (Figure 4, Table 17). However, there was a large, but nonsignificant, increase in 1998, with catch rates improving to 1.30 fish per trawl.

The VIMS striped bass seine survey had its highest values ever recorded in 1996, with trawl catches showing similar high rates during June and July. Indications of a very successful

spawning event include the wide distribution of these fishes far beyond the typical nursery grounds. Large catches were observed down river and well into the main stem bay with catches reported in the surf of the Atlantic Ocean at Sandbridge, VA (VIMS Bluefish seine survey). However, this very successful spawning event was not evident in the index months of December to February, possibly due to mortality or warm winter temperatures which kept fish well dispersed beyond the deep channel areas. The decline in 1997 was also seen in the striped bass seine survey results (Austin et al., 1998).

White Perch (*Morone americana*) - Spawning occurs in the upper tributaries from March to July with a peak occurring from late April to early May. Since white perch populations from various tributaries can exhibit significantly different growth rates (Bowen, 1987; Setzler-Hamilton, 1991; Seaver el al., 1996), and those separations are not clear at this point, for purposes of this analysis all specimens were categorized as either age-0 or age-1+. Examination of distributional data (Appendix Figures 8 & 9), reveals neither year class of white perch are found in the main stem bay, with the highest abundances found in upper portions of each tributary. As a result, index calculations are confined to the upper stratum of each tributary. The temporal component of November to February for age 1+, and December to February for y-o-y, is disturbed only by periodic abundance shown in March for age 1+ individuals, and November and March for y-o-y specimens.

The annual juvenile indices for white perch continued to decline in 1998, dropping to 7.19, as compared to 10.00 (1997) and 21.61 in 1996. The successful 1996 yearclass has been evident the past two years in the age 1+ index (28.64) (Figure 4, Table 18).

White catfish *(Ictalurus catus)* and **Channel catfish** *(I. punctatus)* - The white and channel

catfish are found in relatively high abundance in the upper portions of the tributaries (Appendix Figures 10-13). Although each river system has its specific characteristics, spawning typically occurs in late May through early July in Virginia waters, (Fewlass, 1980; Menzel, 1945), and as such, June has been selected as the start of the biological year. The survey typically catches both species up to 600 mm with juveniles in the size range of 50 mm first recruiting to the gear in June. The temporal component seems very clear for the juveniles occurring from January to April for both species in the up river strata only. The months of January to April will be used for each species' age-1+ components. The index values for the age-1+ component often indicates a higher, more stable trend than the juvenile counterparts. This is due to the fact sampling is over several year classes which aid in stabilizing the population (Figure 5 and Tables 19 and 20). Juvenile channel catfish are often at very low level ranging from 0.0 in 1992, to 1.27 geometric mean catch in 1989. Catch rates for the older fish have usually been five to ten times higher. Exceptions include the 1989 and 1995 year classes which had similar values for both age components (Table 20).

Northern Puffer *(Sphoeroides maculatus)* - The puffer is taken in only small numbers primarily in the main stem bay (Appendix Figure 14). Spawning is somewhat protracted in Chesapeake Bay, beginning in late spring and continuing into fall, peaking in June or July (Laroche and Davis, 1973; Sibunka and Pacheco, 1981). June is considered the start of the biological year with animals captured less than 50 mm. The spatial component is clearly all segments of the bay with catches first appearing in May and peaking during the late summer, July to October.

The species has experienced a rapid, continuous decline during most of the expanded

survey, dropping from a high of 0.85 in 1988, to 0.08 in 1995 (Table 21, Figure 5). However, catch rates have increased slightly from 1996 to 1997, declining again in 1998 to 0.09. This short time series makes it difficult to determine what exactly is causing this recruitment failure.

Silver Perch *(Bairdiella chrysoura)* - The drum, silver perch, uses all strata for its spatial component but interestingly, the York River often dominates catches (Appendix Figure 15). Spawning occurs in the deep waters of the bay and offshore from May to July, and juveniles (100 mm) begin recruiting to the fishing gear by July (Chao and Musick, 1977; Rhodes ,1971). The months September to November have the highest catch rates for all years of the expanded survey except 1991, when August had slightly higher values.

Values have been near constant for the expanded survey, but a large influx to the York River in 1990 made the tributary index 5 times greater than the combined index (Table 22, Figure 5). Since the Chesapeake Bay is near the northern limits of the silver perch's typical range, abundance is probably higher during seasons with above average water temperatures. This may explain the upward trend seen in the early 90's when record temperatures were recorded.

Objective 3: *To complete analyses on gear evaluation and comparison studies which will facilitate the development of a standardized trawl survey and maximize continuity with historical data sets.*

All gear and vessel comparisons studies performed to date have been analyzed and results tabulated (Hata, 1997). Recent efforts have been placed on applying these conversions to historical data and interpreting the results. In circumstances where length samples were large for a given species, a weighted regression of mean size differences, $\overline{D}_L$, was created and applied if

significant. Otherwise, an overall weighted grand mean conversion, $\bar{\bar{D}}$, was calculated and applied if the 95% confidence intervals were significantly different from zero (Hata, 1997). A summary of the results was provided in the last two project segments (Geer and Austin, 1997; Geer and Austin, 1998) and in the detailed report by Hata, 1997.

The procedure to produce a relative estimate of abundance time series from 1955 to the present was similar to that described earlier with two additional steps. First, all station information were post-stratified to the present sampling scheme. This was conducted by applying the appropriate algorithm to the data to designate strata by location and depth. In addition to the regions presently sampled, other regions such as the Chickahominy, Elizabeth, Mattaponi, Piankatank, and Potomac Rivers, as well as Pocomoke Sound, Mobjack Bay, and the Atlantic Ocean, were classified since past surveys were conducted in these regions (Figure 1, Table 9). The second step was to apply the necessary gear and/or vessel conversions to the data to standardize to the present gear and research platform. This was performed by subtracting the appropriate conversion value ($\bar{\bar{D}}$ or $\bar{D}_L$)(Hata, 1997) to the log transformed catch ,ln(catch+1), of an individual sample prior to index calculations. Only the conversion factors significantly different from zero were used.

Time Series Evaluation of Standardized Catches

Spot - The largest adjustments to the spot data appears to occur in the early years of the survey (1955-72). It appears that both the *Pathfinder* and gear U_N_3B_SW (gear code 010) had large effects on catches, and values were necessarily adjusted upward (Figure 6, Table 23). The larger trawl doors used prior to 1991 appear to have produced greater net spread than the china-v trawl doors and as such catches were adjusted slightly downward. A large amount of

noise appears in the time series, with large fluctuations occurring every three to four years (Figure 6). Regardless, considering the extensive sampling the past ten years, the extremely low recruitment years since 1992, appear real and of concern (Figure 6, Table 23).

Atlantic Croaker - The adjusted catches have only a minor effect on both the fall and spring croaker indices. Conversions have been made for nearly all gears and vessels with exception of the *Capt. John Smith* and gear U_T_3b_LW (gear code 043) (Tables 24 and 25). Some of the largest year classes for the fall index have come in recent years (1985, 89, and 96) (Figure 7, Table 24). Its evident from the very low catch rates prior to the addition of a cod-end liner (1972) that the earlier gears rarely capture animals in the smaller size ranges (less than 50mm). The spring index however, has shown large catch rates periodically (Table 25, Figure 8), with the most recent resurgence occurring between 1991 and 1994. This spring index may eventually prove to be a better estimate of recruitment success since it is based on larger sized animals, which have already survived a full winter, and were fully available to all previous gear types.

Weakfish - The most striking observation of the weakfish time series is the very poor recruitment between 1972 and 1977. This broad band of recruitment failure is buffered by successful year classes in 1971 and 1978 (Figure 9 Table 26). Environment factors may have been a cause. However, more likely is the fact that during this period sampling was performed primarily as a semi-annual survey in January/February, then again in July, missing the peak period of abundance which occurs from August to October. Adjustments have been made for all gears except gear 043, and gear 010 with 7.5 minute trawls (Table 26).

Summer Flounder - The only significant conversions are for the gears without a tickler

chain; gears 16L_N_2B_SW (gear code 035), L_N_3B_SW (gear code 033), and U_N_3B_SW (gear code 010 at 15 minutes) (Hata, 1997). The years from 1955 to 1975 are when these gears were most used and the upward adjustment can be noted in the time series (Table 27, Figure 25). The most successful year classes occurred in the early 1980's, followed by a near collapse in recruitment.

Black Sea Bass - The only significant gear difference occurred between the present gear and gear L_N_3B_SW, (VIMS gear code 033) (Hata, 1997). These adjustments occurred between 1970 and 1977, slightly raising index values (Table 28, Figure 11). During years with little or no main stem bay sampling this can be of concern since there are only limited samples for the lower James with typically smaller catches.

Scup - Scup were never caught in large enough numbers during the calibration studies to evaluate catches by size classes. Therefore the grand mean difference, $\bar{\bar{D}}$, was used for conversions. A very large peak in 1962 can be accounted for by several large catches and small sample size (n=6) (Table 29, Figure 12).

Striped Bass - The only conversion applied to the striped bass y-o-y data involved 7.5 minute tows with gear U_N_3B_SW (VIMS gear code 010) against the present configuration. The earlier gear appeared to catch more, adjusting the index downward. The recovery of the striped bass in the 1990's seems small when compared to the catches common in the 1960's (Table 30 and Figure 13).

White Perch - Data have been adjusted for the earliest two gears used by the VIMS Ichthyology Department. Gear U_N_3B_SW with a tow duration of 7.5 minutes adjusted catches downward while a length regression was applied for gear L_N_3B_SW (VIMS gear code 033),

with an upward adjustment (Hata, 1997). The y-o-y white perch do not appear to indicate any obvious trend, with large values recorded for 1995 comparable to many other successful yearclasses (Table 31 and Figure 29). The age 1+ values are often five times greater than the y-o-y counterpart. Largest catches appear during the early years of the survey (1955-65) with catches fairly stable around a mean of 22.3 since 1980 (Figure 15 and Table 32). With sampling being conducted only on the York prior to 1965, these large catch rates for the first ten years of the survey may be artificially skewed.

White and Channel Catfish - The only conversion applied to these catfish species involved gear U_T_3B_LW (VIMS code 043) which was used exclusively by the VIMS Crustaceology Department. Since this gear was used typically only between May and November, there were no impact on the catfish indices which are calculated from January to April. Catches of both y-o-y and age 1+ white cats appear highest in the years before 1965 (Figures 16 and 17, Tables 33 and 34). During these years only the York River was sampled with regularity, possibly biasing catches upward due to its small area. Indices based on individual river systems may prove more useful and deserve further investigation.

The channel cat indices do not show a similar trend. The y-o-y seem to be on the decline while there appears to be an upward trend in age 1+ individuals. The channel catfish was introduced to Virginia in the late 1800's (Jenkins and Burkhead, 1994), and their population trends may be a result of the species becoming established and forming natural cycles as they become integrated into the ecosystem. The y-o-y have shown dramatic decline since the mid 1980's (with the exception of the 1989 year class) (Table 35 and Figure 18), possibly as a result of another introduced catfish, the blue catfish - *Ictalurus furcatus*. Even though, the juvenile

population has been in decline, the adult population appears healthy, with a rough three to four year cycle (Table 36 and Figure 19).

Northern Puffer - Since the puffer's index is estimated from only the main-stem bay, sample sizes (trawls) were often very small if present at all (Table 37). The largest gap occurs between 1983-87, which is of concern, since the first year of the present Bay survey (1988) was the second highest estimate of abundance (Table 37 and Figure 20).

Silver Perch - Conversions have been made for nearly every major period of the program. The earliest years' catches are converted upward when the gear (U_N_3B_SW, gear code 010) was towed for 15 minutes. The VIMS Crustaceology Department's gear U_T_3B_LW (gear code 043, 1972-78) catches were adjusted downward, as were the recent door change (gear code 070). Catches in the years prior to 1971 were on a scale nearly 50 times greater than those seen in recent years (Figure 21 and Table 38). Observations in recent years have indicated relatively even distribution between the rivers and main stem bay, however, catches in the York system are often much higher. Since the York was the only system routinely sampled prior to 1965, it would provide justification for these much higher values.

Objective 4: *Examine the pilot random stratified and fixed transect surveys of the York River and develop similar random stratified designs for both the Rappahannock and James Rivers.*

In the examination of these two survey types for the tributaries, it became evident that both provided significant advantages, while also providing some concerns. The fixed mid-channel transects have been sampled nearly every month for over forty five years - providing a long term basis for comparison. In addition, using the same locations consistently provided assurance

against untrawlable bottom types, submerged hazards, and other problems which can destroy fishing gear. The disadvantages lie in both the range of sampling and the statistical problems created by non-random selection of trawling sites. By sampling only in the channel areas (waters greater than 12ft , $\geq$ 30ft in the lower Rappahannock River), many sampling areas are excluded. Additionally, many of the deep water locations (particularly on the Rappahannock and lower York Rivers), are characteristically anoxic during warm water months, and thus, catches may be minimal. To state these samples represent the population of a fish species on a particular river may be misleading if hypoxia events are common. Statistically, this design violates many of the assumptions associated with population estimate calculations. A random stratified sample design meets these statistical requirements but presents logistic concerns such as additional sampling effort and concerns with untrawlable and unfamiliar sampling locations. The James River proved particularly difficult. Due to its military and commercial importance, many areas (especially those in Hampton Roads), had restrictions, or presented hazards due to submerged materials. In addition, fishing gears (gill nets, pound nets, and crab pots) presented concerns on all rivers. These areas have been identified and commented out from the monthly selection process. The fixed channel stations have been assigned to the appropriate strata and are sampled in addition to the monthly random stations within that strata.

With all this taken into consideration, the RSD was developed and applied to the Rappahannock River beginning in September 1995, and the James starting in March 1996. When a simple geometric mean is calculated on a monthly basis for the fixed transect survey, and compared to a weighted geometric mean from the random surveys, there often appears to be a significant correlation between the surveys for several key species (Geer and Austin, 1996a) (table

39). There seems to be no consistent pattern between, and within, systems to which survey has the higher catch rates. However, with the surveys often showing significant correlation between catch rates, and t-test statistics only occasionally finding significant differences in their means (Table 39), there is confidence to continue applying these surveys to future data collections.

Objective 5: *Establish life history and age structure studies of important species, particularly those where research is limited.*

Data collected from these surveys have been used in several life history studies of target species, including Atlantic croaker (Barbieri et al., 1994), weakfish (Lowery-Barbieri et al., 1995), blackcheek tonguefish (Terwilliger and Munroe, 1999), and white perch (Seaver et al., 1996). Present efforts continue to be placed on lesser studied species, including scup, silver perch, butterfish, and American eel. Preliminary findings on spawning periodicity and weight specific relationships were reported in previous project segments for scup, silver perch, and American eel. Data collection is continuing for these species, with ageing techniques slowly being developed.

Scales are the accepted hard part routinely used for ageing scup (NMFS - NEFSC, per. comm.) To better understand the age structure of those fish captured during routine sampling, nearly 500 samples were collected between 1992 and 1997. Data collected from each specimen included total, fork, and standard length, girth, total weight, as well as scales and sagittal otoliths. 467 scale samples have been read to date. Otoliths were examined to verify scale readings (n = 409). For scale reading, an age of 0.5 was assigned to samples with a large amount of growth but no clear annulus. Similarly, scales with marked growth beyond the first annuli were

designated as 1.5 years of age. A similar method was applied to the otoliths. The preliminary results (Figures 22a and 22b) indicate the scale reading to show higher ages than otolith readings. Both scales and otoliths show 91% of all specimens collected from routine trawl sampling are less than 1.0 years in age with lengths less than 200 mm (Figures 22a and 22b).

The American eel, *Anguilla rostrata*, supports a large commercial fishery in Virginia (Geer, 1997) and is reported as by-catch by many recreational fishers (Table 1). It is commonly captured during monitoring in the upper reaches of the tributaries in the size range of 150 to 350 mm (Geer, 1999). Samples have been collected from the trawl survey, fishers and other monitoring surveys since 1997. To date, over 1000 samples have been collected and measured (total length and girth), weighed, and the sagittal otoliths removed. Otoliths were sectioned and mounted on glass microscope slides to be examined under a dissecting scope at 50X. Preliminary findings show a significant difference ($P \leq 0.05$) in mean length at age between Virginia's major tributaries (James, York, and Rappahannock Rivers). Eels from the York River grew faster than conspecifics from the Rappahannock and James Rivers (Figure 23). Further efforts are underway to collect larger individuals to complete the age-length key.

Butterfish are routinely captured by trawl samples but no comprehensive ageing study has been conducted in Chesapeake Bay. DuPaul and McEachran (1973) conducted a brief study using samples collected by pound net fishermen in September 1969. Efforts are underway to age butterfish from trawl samples (supplemented by commercial samples). This effort has been in cooperation with the ageing lab in the population biology branch at the Northeast Fisheries Science Center of NMFS. The personnel at the lab have agreed to examined images of otoliths placed on the internet and provide their expertise in determining age. To date only a few samples

have been aged, but a length-weight regression has been produced for specimens ranging from 13 to 228 mm (Figure 24).

Silver perch ageing studies have been limited to juveniles along the Georgia coast in a laboratory environment (Hales and Hurley, 1991). Otoliths have proven very difficult to read using various established methods. However, success with scales has been promising. Efforts are underway to complete ageing by scales and results will be available in the near future.

Objective 6: *Conduct monitoring surveys of secondary water systems in the Virginia portion of Chesapeake Bay.*

Initial sampling has been very successful on each of the four secondary water systems selected (Mobjack Bay, Pocomoke Sound, Piankatank and Great Wicomico Rivers). Through June 1999, each system has been sampled a total of 4 times, or once per quarter. This sampling scheme will continue throughout the next project segment at which time data will be examined and sampling adjusting accordingly.

Preliminary results often show higher catch rates in these secondary water systems when compared to monthly catch rates for the Bay, James, York, and Rappahannock River water systems. Summer flounder catch rates were almost always higher in the Mobjack Bay (Tables 40-43), Piankatank (Tables 44-47) and Great Wicomico Rivers (Tables 48-51), particularly during the fall of 1998. Atlantic croaker catches were higher for the Pocomoke Sound in September 1998 (Tables 52 - 55), and Mobjack Bay in November. The Mobjack Bay had higher catch rates of spot each time it was sampled in the fall of 1998, with the Great Wicomico showing similar patterns. The Pocomoke and Mobjack had similar species diversities during the four sampling periods, with an average 23 and 23.5 species captured per trip. The Piankatank and Great

Wicomico Rivers captured fewer species on average (17 and 16.5 respectively). Seasonal patterns were similar to the primary survey, with peak catches occurring in the summer and early fall (Figure 25).

DISCUSSION

Four estimates of relative abundance have been presented. The values reported as the Bay and River indices (BRI) were only for the historic fixed stations transects of the tributaries and the Bay survey as established in 1988. Two indices were presented, one from the tributaries only (1979 to present) and the other for both the Bay and rivers (1988 to present). These estimates have been the standard for this program. With the gear calibration studies now completed, older data can now be post-stratified to provide a standardized measure of relative abundance based on the present sampling scheme. These long time-series have produced converted indices (random stratified converted index - RSCI) and unconverted indices (random stratified index - RSI), for the 12 target species discussed. However, these newly developed indices should be considered preliminary and are still being tested. The actual process of creating conversion values from over 600 comparison trawls was tedious, but most often straight forward. Applying these conversions to over six million observations in the 46 year database was also time consuming. Only those conversions which proved to have mean differences statistically different from zero were used (Hata, 1997).

It is unlikely that post-stratifying past data into the present sampling scheme will cause any major difficulties. All previous random surveys performed by the program were based on some type of depth stratification system. The fixed mid-channel transect stations most often represent

the 12 to 30 ft (3.66-9.14 m) strata. A more pressing issue concerns periods of missing data and/or lack of samples in a particular area. With all data standardized to the present sampling gear and design, missing data can tend to skew results. For example, the silver perch RSI and RSCI indicate very large catch rates prior to 1964, and near zero since (Figure 21). In fact, unconverted catch rates appear 50 times as much as those since the Bay - River index (BRI) was established for data after 1979 . Interpreting these data can cause much speculation and concern. These results are more than likely due to the absence of data from particular systems. The silver perch index is calculated from the months of September to November in all regions presently sampled (James regions J1-J4; York regions Y1-Y4, Rappahannock regions R1-R4, Bay regions B1-B3). It is unlikely missing data from the temporal components would have a large impact. Indices are calculated over a three to four month period of peak abundance, and rarely is peak abundance observed outside that window. The spatial component however, may cause drastic changes if distribution and abundance are not similar between the regions. In the case of silver perch, the York often has the highest catch rates and is the smallest (in area and strata weighing) system sampled. If all systems are sampled, large catches on the York are reduced when multiplied by its small percentage to the total sampling area. Unfortunately, prior to 1964 the York was the only system routinely sampled. Since no other system was sampled, the ratio of each York River strata to the total area for those years was higher, and thus the index was artificially inflated upward.

A method to combat this concern will need to be developed. Applying a simple ratio of catch by system has been suggested, but that assumes a near steady state between systems which may or may not occur. Fortunately for many of these target species, this problem can be resolved

by creating an estimate of abundance for each system as well as a comprehensive value. This can be done for species which are confined to a system by some type of barrier (salinity). White perch, white and channel catfish, and possibly y-o-y striped bass will be further examined in this fashion. The other target species are all highly migratory (even as juveniles), and as such, a single system index would merely reveal nursery utilization for the small temporal period sampled. Other methods will need to be devised to address missing spatial data for these species.

Even though there are still concerns with use of older data in the present sampling scheme, great steps have been made to incorporate these data into a meaningful time-series. Efforts continue on validating older data, and comparing these historical values against data presently being collected. The calibration studies have produced a wealth of information, and have continued to spark interest into other gear and vessel topics. Additionally, the now fully implemented random stratified survey of the tributaries has enhanced the ability to produce reliable estimates of juvenile abundance. These surveys have complimented and correlated with the fixed mid-channel transects quite well since their inception in June 1991 (Geer and Austin, 1996a)(Table 39). With expansion to other regions of interest beginning in July 1998 (particularly Piankatank, Great Wicomico, and Mattaponi Rivers, Mobjack Bay, and Pocomoke Sound), the present annual effort is the highest in the program's history. Major goals for the upcoming year are to address the concerns with the gear conversion values, establish a method to handle missing spatial and temporal data, create new datasets with these new information which can be used (on-line) to address fisheries management concerns, and examine the new habitat data to better understand fish distribution and essential fish habitat.

The juvenile indices presented here must be kept in a geographic context. This is evident

by their absence during the winter months, as the first six species, northern puffer, and silver perch, are highly migratory and only use the Bay nursery grounds during the summer months. Chesapeake Bay constitutes a major nursery area for all of them (with the possible exception of black sea bass and scup) but is certainly only one of several along the Atlantic seaboard for these stocks. With the exception of weakfish and the anadromous species, all of the juveniles recruited to the Chesapeake Bay nursery areas are the result of spawning activities which take place outside of the Bay. Early juveniles of the four sciaenid species are thought to be estuarine dependent, but black sea bass young-of-year also utilize nearshore continental shelf waters (Musick and Mercer, 1977) and juvenile summer flounder also frequent shallow, high salinity coastal lagoons (Wyanski, 1989). Scup do not appear in the bay in appreciable numbers until they are nearing one year old. Conceivably, Chesapeake Bay nursery zone abundances may well be reflective of overall reproductive success, but this will only be verified through comparisons with recruitment in other nursery areas. Assessment of annual recruitment success for coastal Atlantic finfish populations as a whole will require multi-state monitoring efforts, and may complete validation of area-specific juvenile indices.

A random stratified sampling approach, if coupled with knowledge of gear efficiencies and physical sampling frames, can be used to provide population estimates as well as relative indices of abundance. However, 46 years of sampling the same locations, (as it has been performed on the tributary survey) can not be ignore and provides an excellent reference to historical fish stocks. If these fixed locations can be incorporated into a random stratified design, and still meet the assumptions of that design, then there will be a reference point to the past, with a sampling design to meet future research and management goals. It is hoped the initiation of random

stratified surveys on the tributaries will provide the basis for incorporating the fixed tributary stations into a random sampling design. With this design now fully in place, resources should be secured so the present design can remain intact without alteration, to provide a consistent and scientifically sound program for future fisheries needs.

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TABLES

Table 1. 1998 National Marine Fisheries Service's Marine Recreational Fisheries Statistic Survey as compare to the VIMS Juvenile Trawl Survey.

SPECIES	1998 NMFS MRFSS for Virginia				1998 VIMS Trawl Survey		
	Numbers		Weight in kg		Number Caught		
	All Types	Rank	Type A+B1	Rank	Total	Index	Rank
ATLANTIC CROAKER	11,720,722	1	2,685,492	1	84,896	66,057	2
SUMMER FLOUNDER	5,016,682	2	980,024	2	1,121	630	13
SPOT	2,924,108	3	393,096	4	11,700	10,092	6
BLACK SEA BASS	1,729,729	4	186,073	7	189	133	27
WEAKFISH	1,708,474	5	380,679	5	15,705	14,543	4
STRIPED BASS	1,090,380	6	717,391	3	711	509	16
BLUEFISH	628,097	7	173,772	9	19		43
PIGFISH	288,153	8	16,033	17	19		44
OTHER FISHES	284,061	9	213,225	6			
OYSTER TOADFISH	233,599	10	445	31	625		18
FRESHWATER CATFISHES	212,910	11	7,437	20	10,969	3,050	7
KINGFISH	191,252	12	31,069	13	2,549	2,480	11
WINTER SKATE	135,309	13	0	37	142		31
TAUTOG	127,929	14	124,066	10	11		48
SILVER PERCH	124,485	15	2,576	26	983	768	14
SPOTTED SEATROUT	109,192	16	28,072	14	60		35
RED DRUM	106,730	17	15,813	18	2		64
SPANISH MACKEREL	82,569	18	26,067	15	2		65
OTHER TUNAS/MACKERELS	77,398	19	179,820	8			
WHITE PERCH	76,413	20	2,818	25	14,628	4,280	5
SOUTHERN FLOUNDER	62,415	21	6,260	21			
SANDBAR SHARK	58,851	22	8,380	19	2		62
DOLPHINS	50,309	23	92,562	11			
THREADFIN SHAD	48,527	24	0	41	2,911	2,348	10
SCUP	34,749	25	299	33	118	107	32
NORTHERN PUFFER	29,423	26	501	30	55	45	36
LITTLE TUNNY/ATLANTIC	27,189	27	4,585	24			
BLACK DRUM	20,703	28	41,412	12	29		41
SALTWATER CATFISHES	20,319	29	0	38			
OTHER FLOUNDERS	12,332	30	0	40			
OTHER PORGIES	11,872	31	0	44			
MULLETS	11,394	32	0	43			
SMOOTH DOGFISH	11,118	33	6,216	22	1		75
ATLANTIC MACKEREL	8,608	34	4,683	23			
KING MACKEREL	7,606	35	16,999	16			
LOOKDOWN	7,605	36	299	32	11		49
OTHER COD/HAKES	6,805	37	1,727	27	3,031	2,952	9
OTHER SEA BASSES	6,597	38	0	45			
EELS	5,831	39	0	39	797		15
PINFISHES	5,044	40	114	35			
SHEEPSHEAD	4,496	41	1,047	29			
STRIPED SEAROBIN	3,074	42	0	46	553	470	19
GREATER AMBERJACK	2,924	43	44	36			
FLORIDA POMPANO	2,664	44	132	34			
CREVALLE JACK	2,159	45	0	42			
CUNNER	1,849	46	0	48			
TRIGGERFISHES/FILEFISHES	1,461	47	1,567	28			
OTHER TEMPERATE BASSES	676	48	0	47			
Total	27,334,792		6,350,795		151,839	108,464	

KEY: The VIMS data is shown as total catch and index aged components based on 1262 trawls in 1998. VIMS individual species data were combined in accordance with the NMFS reporting records.

Table 2. Substrate, or habitat types described to date (May 1998 to July 1999), with various statistical information.

Substrate Description	Code	Percent of Stations[1]	Mean Quantity[2]	Min	Max
Artificial	ART	0.83	0.49	0.1	2.0
Dead man's fingers	DMF	8.45	0.48	0.1	5.0
Detritus	DET	27.56	0.39	0.1	6.0
Hydroid	HYD	40.45	0.40	0.1	5.0
Mud (soft) bottom	MUD	8.93	1.00	1.0	1.0
Sand (hard) bottom	SND	8.81	1.00	1.0	1.0
Sea Squirts *(Mogula spp.)*	SQT	18.51	0.76	0.1	5.0
Seaweeds (red, green, or brown)	SWD	13.57	0.35	0.1	4.0
Shell (oyster, clam, etc)	SHL	20.42	0.54	0.1	4.0
Sponges (yellow, orange, etc)	SPG	7.20	0.88	0.1	6.0
Submerged Aquatic Vegetation	SAV	4.58	0.53	0.1	3.0
Tube Worms	TUB	7.02	0.26	0.1	1.0
Undetermined	UNK	12.80	1.00	1.0	1.0

Sand and Mud are only used when no other substrate type is present, and verification can be confirmed by direct observation or sediment grab. Values for these and Unknown are always given as 1.0.

1. Based on the number of occurrences of a habitat type divided by the total number of trawls, 1680.

2. Mean Quantity refers only to stations where that habitat type was observed.

Abundance is estimated relative to the capacity of a commercial nest tote (internal dimensions 25.7"x16.7"x10", approximately 72 liters). Categories include: 0.1 = trace, 1 = ¼ bin, 2 = ½ bin, 3 = ¾ bin, 4 = full bin, etc.

Table 3. Number of potential Chesapeake Bay trawl sites and approximate square miles of sampling strata. '*' indicates areas which are not presently being sampled with a RSD.

Region	Stratum	Description	No .of Points	Percent of System	% of Total Sampling	Square Miles (NM)
Bottom Bay	001	West. Shoal 4-12'	1740	9.38	7.49	112.33
Region B1	002	East. Shoal 12-30'	863	4.65	3.26	55.72
	003	Central Plain 30-42'	910	4.91	3.44	58.75
	004	Deep Channel ≥42'	386	2.08	1.46	24.92
	S01	West. Shallow 4-12'	216	1.16	0.82	13.94
	S02	East. Shallow 4-12'	58	0.31	0.22	3.74
			4173	22.50	16.69	269.41
Lower Bay	005	West. Shoal 4-12'	1027	5.54	3.88	66.30
Region B2	006	East. Shoal 12-30'	398	2.15	1.50	25.69
	007	Central Plain 30-42'	1756	9.47	6.63	113.37
	008	Deep Channel ≥42'	684	3.69	2.58	44.16
	S05	West. Shallow 4-12'	215	1.16	0.81	13.88
	S06	East. Shallow 4-12'	145	0.78	0.55	9.36
			4225	22.78	15.95	272.77
Upper Bay	009	West. Shoal 4-12'	768	4.14	2.90	49.58
Region B3	010	East. Shoal 12-30'	632	3.41	2.39	40.80
	011	Central Plain 30-42'	2197	11.84	8.30	141.84
	012	Deep Channel ≥42'	844	4.55	3.19	54.49
	S09	West. Shallow 4-12'	209	1.13	0.79	13.49
	S10	East. Shallow 4-12'	216	1.16	0.82	13.94
			4866	26.23	18.39	314.15
Top Bay*	013	West. Shoal 4-12'	404	2.18	1.53	26.08
Region B4	014	East. Shoal 12-30'	1533	8.26	5.79	98.97
	015	Central Plain 30-42'	1315	7.09	4.97	84.90
	016	Deep Channel ≥42'	1273	6.86	4.81	82.18
	S13	West. Shallow 4-12'	164	0.88	0.62	10.59
	S14	East. Shallow 4-12'	597	3.22	2.26	38.54
			5286	28.50	19.98	341.26
Total Bay			18550		71.01	1197.59

Table 4. Number of potential James River trawl sites and approximate square miles of sampling strata. '*' indicates areas which are not presently being sampled with a RSD. The weight factors (No. of Points) have been altered to remove several creeks and rivers.

Region	Stratum	Description	No .of Points	Percent of System	% of Total Sampling	Square Miles (NM)
Bottom James Region J1	070	Bottom JA 4-12'	416	16.57	1.57	27.31
	071	Bottom JA 12-30'	292	11.63	1.10	18.85
	072	Bottom JA 30-42'	68	2.71	0.26	4.39
	073	Bot & Low JA ≥42'	59	2.35	0.22	3.81
	*JH1	Hampton R. 4-12'	5	0.20	0.02	0.32
	*JK1	Chuckatuck R. 4-12'	2	0.08	0.01	0.13
	*JN1	Nansemond R. 4-12'	67	2.67	0.25	4.33
	*JN2	Nansemond R. ≥ 12'	16	0.64	0.06	1.03
			925	36.28	3.49	59.72
Lower James Region J2	074	Lower JA 4-12'	389	15.50	1.47	25.11
	075	Lower JA 12-30'	230	9.16	0.87	14.85
	076	Lower JA 30-42'	25	1.00	0.09	1.61
	*JP1	Pagan R. 4-12'	47	1.87	0.18	3.03
	*JP2	Pagan R. ≥12'	10	0.40	0.04	0.65
	*JW1	Warwick R. 4-12'	50	1.99	0.19	3.23
	*JW2	Warwick R. ≥ 12'	3	0.12	0.01	0.19
			754	30.04	2.85	48.68
Upper James Region J3	077	Upper JA 4-12'	178	7.09	0.67	11.49
	078	Upper JA 12-30'	172	6.85	0.65	11.10
	079	Up & Top JA ≥ 30'	34	1.35	0.13	2.20
	*JS1	Skiffles Cr. 4-12'	25	1.00	0.09	1.61
	*JS2	Skiffles Cr. ≥12'	6	0.24	0.02	0.39
			415	16.53	1.56	26.79
Top James Region J4	080	Top JA 4-12'	264	10.52	1.00	17.04
	081	Top JA 12-30'	152	6.06	0.57	9.81
			416	16.58	1.79	26.86
TOTAL James R.			2510		9.47	162.05

Table 5. Number of potential York River trawl sites and approximate square miles of sampling strata. '*' indicates areas which are not presently being sampled with a RSD.

Region	Stratum	Description	No .of Points	Percent of System	% of Total Sampling	Square Miles (NM)
Bottom York	030	Bottom YK 4-12'	94	12.18	0.36	6.07
Region Y1	031	Bottom YK 12-30'	87	11.27	0.33	5.62
	032	Bottom YK 30-42'	66	8.55	0.25	4.26
	033	Bot & Low YK≥42	71	9.20	0.27	4.58
			318	41.19	1.21	20.53
Lower York	034	Lower YK 4-12'	111	14.38	0.42	7.17
Region Y2	035	Lower YK 12-30'	114	14.77	0.43	7.36
	036	Lower YK 30-42'	28	3.63	0.11	1.81
			253	32.77	0.96	16.33
Upper York	037	Up & Top YK 4-12'	54	6.99	0.20	3.49
Region Y3	038	Upper YK 12-30'	71	9.20	0.27	4.58
	039	Up & Top YK≥30'	29	3.76	0.11	1.87
			154	19.95	0.58	9.94
Top York*	040	Top YK 12-30'	47	6.09	0.18	3.03
Region Y4			47	6.09	0.18	3.03
TOTAL York R.			772		2.93	49.83

Table 6. Number of potential Rappahannock River trawl sites and approximate square miles of sampling strata. '*' indicates areas which are not presently being sampled with a RSD.

Region	Stratum	Description	No .of Points	Percent of System	% of Total Sampling	Square Miles (NM)
Bottom Rappahannock	050	Bottom RA 4-12'	98	7.08	0.37	6.33
Region R1	051	Bottom RA 12-30'	200	14.44	0.76	12.91
	052	Bottom RA 30-42'	66	4.77	0.25	4.26
	053	Bottom RA ≥ 42'	84	6.06	0.32	5.42
			448	32.35	1.70	28.92
Lower Rappahannock	054	Lower RA 4-12'	94	6.79	0.36	6.07
Region R2	055	Lower RA 12-30'	167	12.06	0.63	10.78
	056	Lower RA 30-42'	67	4.84	0.25	4.33
	057	Lower RA ≤ 42'	56	4.04	0.21	3.62
			384	27.73	1.45	24.79
Upper Rappahannock	058	Upper RA 4-12'	233	16.82	0.88	15.04
Region R3	059	Upper RA 12-30'	101	7.29	0.38	6.52
	060	Up & Top RA ≥30'	32	2.31	0.12	2.07
			366	26.43	1.38	23.63
Top Rappahannock	061	Top RA 4-12'	137	9.89	0.52	8.84
Region R4	062	Top RA 12-30'	50	3.61	0.19	3.23
			187	13.50	0.71	12.07
TOTAL Rapp. R.			1385		5.24	89.41
TOTAL SITES			26,474			1498.89

Table 7. Number of potential trawl sites and approximate square miles of exploratory sampling strata for the Pocomoke River, Mobjack Bay, and Great Wicomico and Piankatank Rivers.

Region	Stratum	Description	No .of Points	Percent of System	Square Miles (NM)	Number of Samples per Quarter
Pocomoke Sound Region CP	110	CP 4-12'	734	63.17	47.39	4
	111	CP 12-30'	344	29.60	22.21	4[A]
	112	CP 30-42'	30	2.58	1.94	3[A]
	113	CP ≥42'	54	4.65	3.49	3[A]
			1162		75.02	14
Mobjack Bay Region MB Severn, Ware, East, & North Rivers	090	MB 4-12'	114	17.17	7.36	4[A]
	091	MB ≥ 12'	310	46.69	20.01	5[B]
	092	MB Tribs. 4-12'	154	23.19	9.94	2
	093	MB Tribs. ≥ 12'	86	12.95	5.55	6[C]
			664		42.87	17
Great Wicomico River Region GW	121	GW 4-12'	154	78.57	9.94	3
	122	GW ≥ 12'	42	21.43	2.71	3
			196		12.65	6
Piankatank River Region PK	105	PK 4-12'	133	50.57	8.59	2
	106	PK ≥ 12'	130	49.43	8.39	5[D]
			263		16.98	7

Number of Fixed Stations: A=1, B=2, C=4, D=3

Table 8. Assignment of fixed tributary stations to potential random strata used in the original Bay-River index (BRI) calculations and assignment to strata of the random stratified design surveys. Alternating shaded areas represent the number of points and area used as a weighting factor for the BRI index calculations.

River	River Mile	Depth (ft)	Index Strata	No. Of Points	Sq. Naut. Miles	RSD Strata
James R.	J01	25.0	JA01	687	44.35	071
	J05	20.0	JA01			071
	J13	30.2	JA01			076
	J17	22.0	JA01			075
	J24	35.0	JA02	364	23.50	079
	J27	28.0	JA02			078
	J35	29.0	JA02			081
	J40	12.0	JA02			081
York R.	Y02	35.0	YK01	372	24.02	032
	Y05	40.0	YK01			032
	Y10	29.9	YK01			035
	Y15	25.0	YK01			035
	Y20	20.0	YK02	184	11.88	038
	Y25	25.0	YK02			038
	Y30	20.0	YK02			040
	Y35	20.0	YK02			040
	Y40	13.0	YK02			040
Rappahannock R.	R02	60.0	RA01	283	18.27	053
	R10	60.0	RA01			053
	R15	50.0	RA01			057
	R20	50.0	RA01			057
	R25	29.9	RA02	190	12.26	059
	R30	20.0	RA02			062
	R35	20.0	RA02			062
	R40	12.1	RA02			062

James River: JA01 - Lower ≥ 12ft. JA02 - Upper ≥ 12ft.

York River: YK01 - Lower ≥ 12ft. YK02 - Upper ≥ 12ft.

Rapp. River: RA01 - Lower ≥ 30ft. RA02 - Upper ≥ 12ft.

Table 9. Summary of samples collected, 1955 - July 1999. Includes sampling from the recent RSD surveys of the tributaries (June 1991 to present). Shaded boxes indicate those areas affected by the engine failure of the R/V *Fish Hawk* in August 1998.

KEY

Sample Type:	ALL	All fish species and blue crabs sampled, VIMS code 104
	CRAB	Only blue crabs sampled, VIMS code 102
	FISH	Only fish species sampled, VIMS code 090
System:	CL	Lower Chesapeake Bay (Virginia Portion)
	JA	James River
	PO	Potomac River
	RA	Rappahannock River
	YK	York River
	OT	Includes: Atlantic Ocean (AT) - 1971, 78-79; Piankatank R. (PK) - 1970-71, 98-99; Mobjack Bay (MB) - 1970-73, 98-99; Pocomoke Sound (CP) -1973-81, 98-99; Great Wicomico R. (GW) - 1998-99.
Vessel:	BR	W.K. Brooks
	FH	Fish Hawk
	JS	Captain John Smith, J1 prior to 1986.
	LA	Langley
	PA	Pathfinder
	RE	Restless
	OT	Includes: Aquarius (AQ) - 1978; Investigator (IN) - 1970; Judith Ann (JA) - 1981; Langley II (LN) - 1985; Sally Jean (SJ) - 1981; Outboard Skiff (SK) - 1970-71; Three Daughters (TD) - 1978; Virginia Lee (VL) - 1955-57; Edith May (EM) - 1984.
Gear Code:	010	Unlined, no tickler chain, 30' bridle, 48"x22" otter board doors, U_N_3B_SW
	033	Lined, no tickler chain, 30' bridle, 48"x22" doors, L_N_3B_SW
	043	Unlined, tickler chain, 30' bridle, 54"x24" doors, U_T_3B_LW
30' Gears	068	Lined, tickler chain, 30' bridle, 54"x24" otter board doors, L_T_3B_LW
	070	Lined, tickler chain, 60' bridle, 54"x24" doors, L_T_6B_LW
	108	Lined, tickler chain, 60' bridle, metal china-v doors, L_T_6B_CV

OT includes 3 configurations of 16 foot nets.

used	035: Lined, no tickler chain, 23' bridle, 24"x12" otter board doors, 16L_N_2B_SW. Main Gear
	009: Unlined, no tickler chain, 16U_N_2B_SW. 19 tows in 1972.
	067: Lined, w/ tickler chain, 16L_T_2B_SW. 60 samples on the Elizabeth River in 1982-83.
Station Type:	F - Fixed
	R - Random
Tow Type:	OT is tow duration in minutes for those not listed.
	DIS is distance, always 0.25 nautical miles. Equates well to 5 minute duration.

All Codes found on table are in Wojcik and Van Engel, 1988. Appendices A - C.

Table 9. Sample collection history of the VIMS trawl survey, 1955 - August 1999. RSD surveys (1991- present) of the tributaries included. Shaded boxes indicate areas not completed in August 1998. Codes are on attached key.

YR	TOT	SAMPLE TYPE			MONTH												WATER SYSTEM						RESEARCH VESSEL							GEAR CODE							STAT. TYPE		TOW DURATION/DISTANCE				
		ALL	CRAB	FISH	J	F	M	A	M	J	J	A	S	O	N	D	CL	JA	PO	RA	YK	ZZ	BR	FH	JS	LA	PA	RE	ZZ	10	33	43	68	70	108	OT	F	R	5	7.5	15	OT	DIS
1955	31	0	0	31	0	3	1	3	1	5	14	1	3	0	0	0	6	0	0	0	25	0	0	0	0	0	0	0	31	31	0	0	0	0	0	0	31	0	0	12	17	2	0
1956	135	103	0	32	0	0	0	16	17	0	17	20	17	16	16	16	43	0	0	0	92	0	0	0	0	0	0	0	135	135	0	0	0	0	0	0	135	0	0	6	127	2	0
1957	141	113	0	28	12	16	16	0	12	0	4	16	17	16	16	16	46	0	0	0	95	0	0	0	0	0	85	0	56	141	0	0	0	0	0	0	141	0	0	44	97	0	0
1958	192	167	0	25	16	16	13	16	19	16	15	17	16	16	16	16	56	0	0	0	136	0	0	0	0	0	192	0	0	192	0	0	0	0	0	0	192	0	0	58	134	0	0
1959	117	86	2	29	0	0	0	14	3	16	19	16	16	16	17	0	32	0	0	0	85	0	0	0	0	0	117	0	0	117	0	0	0	0	0	0	117	0	0	34	83	0	0
1960	57	42	0	15	0	0	0	0	16	14	14	13	0	0	0	0	19	0	0	0	38	0	0	0	0	0	57	0	0	57	0	0	0	0	0	0	57	0	0	10	44	3	0
1961	89	19	16	54	6	0	0	4	10	12	8	8	11	12	10	8	15	0	0	0	74	0	0	0	0	0	89	0	0	89	0	0	0	0	0	0	89	0	0	26	63	0	0
1962	116	6	35	75	8	8	8	5	12	19	8	8	11	11	11	7	18	0	0	17	81	0	0	0	0	22	94	0	0	116	0	0	0	0	0	0	116	0	0	31	84	1	0
1963	142	25	45	72	6	8	9	13	16	18	14	9	19	13	9	8	19	0	0	22	101	0	0	0	0	63	79	0	0	142	0	0	0	0	0	0	142	0	0	37	102	3	0
1964	187	104	36	47	23	9	9	12	20	19	18	15	14	19	14	15	21	62	0	0	104	0	0	0	0	75	112	0	0	187	0	0	0	0	0	0	187	0	1	36	146	4	0
1965	189	106	5	78	22	13	17	14	14	14	14	19	14	15	12	21	1	71	0	23	94	0	0	0	0	44	145	0	0	189	0	0	0	0	0	0	189	0	0	38	145	6	0
1966	214	138	3	73	14	21	25	16	17	17	17	23	13	18	16	17	21	70	0	9	114	0	0	0	0	184	30	0	0	214	0	0	0	0	0	0	214	0	0	51	163	0	0
1967	259	196	2	61	15	17	32	17	17	24	23	23	22	23	23	23	23	68	0	60	108	0	0	0	0	16	243	0	0	259	0	0	0	0	0	0	259	0	0	57	193	9	0
1968	262	215	2	45	14	16	16	23	23	23	21	31	23	23	23	26	23	70	0	65	104	0	0	0	0	4	258	0	0	259	3	0	0	0	0	0	262	0	10	66	180	6	0
1969	286	281	1	4	23	23	24	24	24	24	24	24	24	24	24	24	23	72	0	83	108	0	0	0	0	0	286	0	0	286	0	0	0	0	0	0	286	0	1	86	189	10	0
1970	359	276	1	82	17	24	24	24	24	24	51	24	51	23	51	22	23	70	0	80	105	81	14	0	0	0	314	0	31	305	0	0	0	0	0	54	359	0	3	173	177	6	0
1971	804	346	57	401	51	18	51	55	61	63	103	82	74	82	82	82	24	80	0	96	449	155	154	0	0	50	358	234	8	372	0	32	0	0	0	400	572	232	440	172	189	3	0
1972	843	168	89	586	73	73	73	56	56	75	71	85	35	98	94	54	14	86	0	87	545	111	73	0	0	154	185	431	0	238	0	101	0	0	0	504	498	345	657	96	89	1	0
1973	871	179	0	692	54	53	11	56	80	202	91	91	105	105	23	0	88	67	0	80	591	45	126	0	0	64	237	444	0	0	122	179	0	0	0	570	304	567	751	0	0	120	0
1974	748	175	0	573	156	137	75	0	27	26	166	62	55	26	18	0	138	147	73	174	216	0	0	0	0	568	105	75	0	0	498	175	0	0	0	75	478	270	257	0	0	38	453
1975	795	435	7	353	194	128	16	0	18	18	349	18	18	18	18	0	162	148	60	194	231	0	117	0	0	429	176	73	0	0	535	126	0	0	0	134	126	669	471	0	0	2	322
1976	1141	308	0	833	184	141	23	40	40	40	525	40	40	36	32	0	174	340	60	318	249	0	230	0	6	466	262	177	0	0	426	308	0	0	0	407	308	833	816	0	0	0	325
1977	876	182	0	694	0	0	182	0	26	26	493	71	26	26	26	0	113	243	8	284	228	0	172	0	23	269	130	282	0	0	240	182	0	0	0	454	182	694	771	0	0	0	105
1978	1130	208	0	922	94	214	79	0	26	90	396	66	26	26	26	87	171	366	78	220	285	10	22	0	73	544	153	179	159	0	583	181	0	0	0	366	181	949	551	0	16	2	561
1979	810	321	0	489	282	70	124	0	36	41	47	46	37	44	44	39	60	267	63	159	260	1	0	0	43	371	333	63	0	2	461	0	284	0	0	63	285	525	485	0	0	2	323
1980	559	248	0	311	28	48	46	18	49	51	50	50	58	52	52	57	129	145	0	115	170	0	0	0	367	0	192	0	0	0	140	0	0	419	0	0	362	197	558	0	0	1	0
1981	486	243	1	242	41	34	52	17	52	46	52	24	39	42	38	49	52	146	18	97	173	0	0	0	424	0	16	0	46	0	0	0	0	486	0	0	295	191	478	0	0	8	0
1982	580	261	0	319	11	67	80	54	53	40	40	45	50	46	46	48	43	180	37	140	180	0	0	0	580	0	0	0	0	0	0	0	0	538	0	42	364	216	577	0	0	3	0
1983	482	295	0	187	32	54	14	15	40	39	39	38	38	65	50	58	0	162	19	118	183	0	0	0	482	0	0	0	0	0	0	0	0	465	0	17	367	115	478	0	0	4	0
1984	475	261	1	213	19	13	38	45	50	49	47	46	37	49	49	33	0	212	21	95	147	0	0	0	461	0	0	0	14	0	3	0	0	472	0	0	475	0	471	0	0	4	0
1985	335	191	0	144	36	26	26	26	35	12	39	39	27	45	0	25	0	120	17	75	123	0	0	0	285	0	0	0	50	0	0	0	0	335	0	0	335	0	333	0	0	2	0
1986	374	374	0	0	22	24	25	24	37	35	37	37	37	37	36	23	0	135	0	117	122	0	0	0	374	0	0	0	0	0	0	0	0	374	0	0	374	0	374	0	0	0	0
1987	334	334	0	0	23	24	23	24	36	37	33	34	32	34	34	0	0	108	0	108	118	0	0	0	334	0	0	0	0	0	0	0	0	334	0	0	334	0	333	0	0	0	1
1988	889	802	87	0	69	69	62	48	82	82	82	82	82	82	80	69	576	97	0	105	111	0	0	0	889	0	0	0	0	0	0	0	0	889	0	0	313	576	885	0	0	0	4
1989	840	749	91	0	61	61	61	66	76	76	76	76	76	76	59	479	108	0	124	129	0	0	0	840	0	0	0	0	0	0	0	0	0	840	0	0	361	479	840	0	0	0	0
1990	827	739	88	0	61	61	61	61	76	76	77	75	76	69	76	58	473	108	0	119	127	0	0	279	548	0	0	0	0	0	0	0	0	827	0	0	354	473	826	0	0	0	1
1991	930	840	90	0	61	25	61	61	73	94	95	95	97	97	97	74	411	108	0	120	291	0	0	930	0	0	0	0	0	0	0	0	0	0	930	0	357	573	928	0	0	1	1
1992	982	891	91	0	79	47	79	79	97	88	88	88	89	88	88	72	404	110	0	124	344	0	0	982	0	0	0	0	0	0	0	0	0	0	982	0	361	621	975	0	0	7	0
1993	915	824	91	0	40	73	40	71	88	89	88	88	88	88	87	75	370	110	0	126	309	0	0	915	0	0	0	0	0	0	0	0	0	0	915	0	365	550	914	0	0	1	0
1994	911	820	91	0	40	73	40	73	88	88	88	88	88	88	88	69	368	110	0	124	309	0	0	911	0	0	0	0	0	0	0	0	0	0	911	0	363	548	906	0	0	5	0
1995	993	980	13	0	40	73	40	73	92	88	88	88	105	105	99	102	411	96	0	201	285	0	0	993	0	0	0	0	0	0	0	0	0	0	993	0	314	679	984	0	0	9	0
1996	1176	1176	0	0	52	91	71	106	106	107	108	108	107	108	107	105	435	228	0	258	255	0	0	1176	0	0	0	0	0	0	0	0	0	0	0	1176	0	279	897	1168	0	0	6	2
1997	1220	1220	0	0	68	105	66	98	110	111	111	112	111	112	111	105	425	265	0	264	266	0	0	1220	0	0	0	0	0	0	0	0	0	0	1220	0	302	918	1217	0	0	3	0
1998	1262	1262	0	0	66	105	66	105	111	111	128	59	139	124	130	119	389	265	0	256	264	89	0	1262	0	0	0	0	0	0	0	0	0	0	1262	0	322	940	1261	0	0	1	0
1999	813	813	0	0	79	122	80	122	121	117	119		0	0	0	0	195	154	0	154	155	102	0	813	0	0	0	0	0	0	0	0	0	0	813	0	211	602	811	0	0	2	0
TOT	26177	17522	945	7710	2192	2203	1859	1594	2087	2262	4006	2100	2062	2113	1965	1681	6492	5194	454	4811	8579	594	908	9481	5729	3323	4248	1958	530	3331	3011	1284	284	5979	9202	3086	12518	13659	20531	1033	2238	277	2098

Table 10. Spatial, temporal and length criteria used to calculate indices.

VIMS Trawl Survey - Area/Time/Size Values by Species

Species-Age	VIMS	Strata Used									Month												
	SP. CODE	Bay			James		York		Rapp		Size Cutoff Values - Darkened Areas Represent Index Months												
		Bot'm	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	January	February	March	April	May	June	July	August	September	October	November	December
Atlantic Croaker Y-O-Y	0005										0-100	0-100	0-100	0-110	0-135	0-160	0-180	0-220	0-50	0-80	0-100	0-100
Atlantic Croaker Recruits	0005										0-100	0-100	0-100	0-110	0-135	0-160	0-180	0-220	0-50	0-80	0-100	0-100
Black Seabass Y-O-Y	0002										0-110	0-110	0-110	0-110	0-110	0-150	0-175	0-70	0-85	0-100	0-105	0-110
Channel Catfish Y-O-Y	0040										0-130	0-130	0-130	0-140	0-150	0-50	0-80	0-105	0-120	0-130	0-130	0-130
Channel Catfish 1 +	0040										>130	>130	>130	>140	>150	>50	>80	>105	>120	>130	>130	>130
Northern Puffer Y-O-Y	0050										0-140	0-140	0-140	0-160	0-185	0-50	0-85	0-120	0-130	0-135	0-140	0-140
Scup 1 + (?)	0001										90-170	90-170	90-170	90-170	35-90	40-100	50-125	60-145	75-160	85-170	90-170	90-170
Silver Perch Y-O-Y	0213										0-160	0-160	0-160	0-160	0-165	0-170	0-100	0-130	0-150	0-160	0-160	0-160
Spot - Y-O-Y	0033										0-200	0-200	0-50	0-75	0-100	0-135	0-160	0-180	0-200	0-200	0-200	0-200
Striped Bass Y-O-Y	0031										0-200	0-200	0-200	0-200	0-50	0-80	0-100	0-120	0-135	0-150	0-175	0-190
Sum. Flounder Y-O-Y	0003										0-290	0-290	0-60	0-100	0-140	0-170	0-200	0-225	0-250	0-275	0-290	0-290
Weakfish - Y-O-Y	0007										0-200	0-200	0-200	0-225	0-240	0-90	0-120	0-150	0-180	0-200	0-200	0-200
White Catfish Y-O-Y	0039										0-110	0-110	0-110	0-110	0-120	0-50	0-65	0-80	0-90	0-100	0-110	0-110
White Catfish 1 +	0039										>110	>110	>110	>110	>120	>50	>65	>80	>90	>100	>110	>110
White Perch Y-O-Y	0032										0-85	0-85	0-85	0-95	0-35	0-65	0-73	0-80	0-85	0-85	0-85	0-85
White Perch 1 +	0032										86-300	86-300	86-300	96-300	36-300	66-300	74-300	81-300	86-300	85-300	86-300	86-300

Table 11. Bay-River (BRI) juvenile abundance indices for spot. Values are given for both the Bay and River surveys (BRI) combined, as well as the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from bay data and fixed stations of the tributaries only.

		BAY and RIVER SURVEYS				RIVER SURVEY ONLY			
Species	Year	Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Spot YOY	1979					17.29	12.90-23.05	4.71	123
	1980					8.94	6.33-12.50	6.65	146
	1981	Bay data not collected in a similar manner				31.06	23.94-40.22	3.62	137
	1982					36.52	27.08-49.14	4.00	151
	1983					21.51	17.20-26.84	3.41	151
	1984					50.28	33.71-74.74	4.95	132
	1985					19.59	13.32-28.60	6.00	118
	1986					26.32	20.32-34.01	3.75	144
	1987					20.45	14.69-28.34	5.10	133
	1988	67.45	46.98-96.66	4.20	231	50.20	29.89-83.86	6.42	84
	1989	32.27	25.37-40.97	3.32	252	54.19	37.79-77.53	4.40	84
	1990	45.28	33.01-61.98	4.02	248	53.06	38.41-73.14	3.96	81
	1991	16.56	12.59-21.68	4.47	238	21.44	14.85-30.77	5.59	83
	1992	1.96	1.49-2.52	7.98	238	4.39	2.87-6.51	9.86	82
	1993	9.74	7.26-12.95	5.51	240	11.85	7.85-17.64	7.29	84
	1994	9.07	6.80-12.00	5.53	240	8.88	5.49-14.02	9.15	84
	1995	1.52	1.15-1.95	8.55	248	2.37	1.56-3.44	11.34	92
	1996	4.52	3.44-5.85	6.65	244	4.84	3.20-7.13	9.36	88
	1997	8.63	6.57-11.26	5.32	256	19.68	14.55-26.50	4.71	100
	1998	1.88	1.35-2.53	9.66	214	3.04	1.89-4.63	11.96	96

Table 12. Bay -River (BRI) juvenile abundance indices for Atlantic croaker. Values are given for both the Bay and River surveys (BRI) combined, as well as the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from bay data and fixed stations of the tributaries only.

Species	Year	Spring Recruits (River & Bay)				Fall (Juveniles) Rivers Only			
		Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Atlantic	1979					4.69	2.77-7.6	11.88	63
Croaker	1980					2.53	1.47-4.03	14.07	70
	1981	Bay data not collected in a similar manner				2.86	1.81-4.32	11,81	75
	1982					3.20	2.23-4.45	9.12	102
	1983					7.32	4.78-10.97	8.59	103
	1984					45.77	29.35-71.09	5.62	86
	1985					74.98	40.28-138.87	7.05	57
	1986					12.63	8.99-17.58	5.94	94
	1987					6.49	4.29-9.59	8.61	68
	1988	0.38	0.25-0.53	15.64	234	9.05	5.98-13.46	7.88	65
	1989	0.78	0.52-1.08	13.48	252	64.78	37.9-110.23	6.27	65
	1990	0.52	0.3-0.79	19.06	252	13.15	8.89-19.24	6.76	60
	1991	4.35	3.03-6.11	8.46	238	9.57	5.86-15.28	9.16	63
	1992	1.34	0.91-1.86	11.97	240	14.59	8.3-25.15	9.41	67
	1993	2.21	1.54-3.07	10.15	240	5.42	3.73-7.72	8.21	69
	1994	0.95	0.64-1.32	13.01	240	13.48	8.36-21.41	8.17	67
	1995	0.93	0.67-1.23	11.09	246	11.79	7.71-17.77	7.53	69
	1996	0.16	0.08-0.24	23.56	242	31.06	18.56-51.54	7.12	69
	1997	0.87	0.62-1.16	11.43	255	10.41	6.77-15.75	7.88	75
	1998	0.48	0.33-.063	13.04	214	21.26	15.33-29.34	4.99	75
prelim. *	1999	0.25	0.17-.034	15.3	115				

Table 13. Bay-River (BRI) juvenile abundance indices for weakfish. Values are given for both the Bay and River surveys (BRI) combined, as well as the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from bay data and fixed stations of the tributaries only.

		BAY and RIVER SURVEYS				RIVER SURVEY ONLY			
Species	Year	Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Weakfish	1979					7.18	4.86-10.4	7.91	95
YOY	1980					9.87	6.75-14.25	7.09	111
	1981	Bay data not collected in a similar manner				6.02	4.32-8.24	7.08	99
	1982					10.95	7.91-15.01	5.90	113
	1983					10.85	8.45-13.84	4.56	112
	1984					6.05	3.73-9.52	10.22	97
	1985					37.04	27.84-49.18	3.81	81
	1986					4.62	2.84-7.21	11.00	108
	1987					17.85	12.78-24.78	5.33	100
	1988	8.89	5.95-13.08	7.70	173	21.72	12.34-37.67	8.52	63
	1989	12.22	8.62-17.18	6.16	189	21.27	13.2-33.92	7.25	63
	1990	4.87	3.43-6.77	7.96	184	30.01	18.56-48.17	6.71	59
	1991	3.56	2.65-4.71	7.36	179	15.32	9.42-24.55	8.03	62
	1992	6.93	4.9-9.66	7.14	178	15.91	9.78-25.52	7.96	61
	1993	6.12	4.33-8.51	7.37	180	15.42	8.44-27.56	9.89	63
	1994	2.67	1.89-3.66	9.18	180	7.04	4.07-11.77	11.08	63
	1995	6.07	4.34-8.37	7.18	186	11.00	6.74-17.61	8.83	69
	1996	7.85	5.59-10.87	6.74	183	7.42	4.33-12.3	10.72	66
	1997	7.15	5.36-9.45	5.92	192	14.82	8.84-24.42	8.59	75
	1998	8.18	5.65-11.67	7.26	150	9.95	6.41-15.20	8.18	71

Table 14. Bay-River (BRI) juvenile abundance indices for summer flounder. Values are given for both the Bay and River surveys (BRI) combined, as well as the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from bay data and fixed stations of the tributaries only.

Species	Year	BAY and RIVER SURVEYS				RIVER ONLY SURVEYS			
		Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Summer Flounder YOY	1979					1.01	0.56-1.59	18.18	48
	1980					7.60	5.01-11.31	8.34	58
	1981	Bay data not collected in a similar manner				5.10	3.49-7.28	8.44	61
	1982					4.30	2.78-6.43	10.11	60
	1983					5.21	3.73-7.15	7.44	62
	1984					1.90	1.16-2.88	13.75	45
	1985					1.11	0.54-1.89	21.20	27
	1986					1.27	0.82-1.82	13.43	53
	1987					0.45	0.2-0.75	25.47	52
	1988	0.53	0.35-0.74	14.94	143	0.54	0.21-0.97	28.41	36
	1989	1.23	0.94-1.56	8.64	162	0.96	0.57-1.43	16.37	36
	1990	2.54	2.07-3.09	5.68	162	2.61	1.73-3.77	10.85	36
	1991	2.78	2.26-3.38	5.56	153	1.42	0.88-2.11	14.35	36
	1992	0.91	0.7-1.15	9.12	153	0.49	0.23-0.8	23.52	36
	1993	0.53	0.39-0.69	11.61	153	0.49	0.26-0.77	21.44	36
	1994	2.50	1.98-3.11	6.39	153	1.08	0.51-1.88	22.06	36
	1995	0.72	0.53-0.93	10.71	149	0.74	0.37-1.21	21.81	36
	1996	0.86	0.64-1.1	9.81	153	0.62	0.34-0.96	19.57	36
	1997	0.97	0.74-1.23	9.13	153	0.70	0.36-1.13	20.90	36
	1998	0.78	0.58-1.01	10.33	153	0.17	0.03-0.31	39.17	36

Table 15. Bay-River (BRI) juvenile abundance indices for black sea bass. Values are given for both the Bay and River surveys (BRI) combined, as well as the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from bay data and fixed stations of the tributaries only.

		BAY & RIVER SURVEYS				RIVERS ONLY SURVEYS			
Species	Year	Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Black Sea	1978					0.86	0-2.74	56.50	16
Bass YOY	1979					0.15	0-0.36	62.15	23
	1980					0.31	0-0.73	52.28	23
	1981	Bay data not collected in a similar manner				0.30	0.02-0.65	45.77	22
	1982					0.40	0.1-0.8	36.30	25
	1983					0.44	0-1.05	49.37	16
	1984					0.73	0.04-1.88	46.54	12
	1985					1.19	0.3-2.72	33.51	18
	1986					0.27	0.05-0.54	40.54	18
	1987	1.58	1.08-2.19	11.36	124	0.95	0.2-2.18	36.66	12
	1988	0.83	0.58-1.13	12.10	138	1.04	0.19-2.51	37.89	12
	1989	2.36	1.7-3.17	8.97	138	1.52	0.24-4.11	38.16	12
	1990	1.12	0.78-1.52	11.63	128	0.50	0.01-1.23	49.30	12
	1991	1.29	0.91-1.74	10.88	129	2.35	0.55-6.26	31.99	12
	1992	0.22	0.14-0.32	18.70	129	0.19	0-0.43	52.22	12
	1993	1.04	0.73-1.4	11.54	129	0.76	0.11-1.79	40.42	12
	1994	1.06	0.73-1.44	11.84	129	0.60	0.03-1.5	46.95	12
	1995	0.54	0.36-0.75	14.66	127	0.62	0.03-1.57	47.43	12
	1996	0.35	0.22-0.49	16.77	128	0.38	0.03-0.85	45.47	12
	1997	0.47	0.31-0.65	14.62	129	0.23	0-0.54	54.05	12
prelim, *	1998	0.65	0.37-0.98	18.33	74	0.19	0-0.49	65.47	8

Table 16. Bay-River (BRI) juvenile abundance indices for scup. Values are given for both the Bay and River surveys (BRI) combined, as well as the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from bay data and fixed stations of the tributaries only.

		BAY & RIVERS SURVEY				RIVERS ONLY SURVEY			
Species	Year	Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Scup YOY	1979								
	1980								
	1981	Bay data not collected in a similar manner							
	1982								
	1983								
	1984								
	1985								
	1986								
	1987	2.07	1.24-3.21	14.10	92	Index based on Bay data only			
	1988	3.06	2.05-4.41	10.20	112				
	1989	4.92	3.14-7.45	10.03	112				
	1990	1.90	1.11-2.99	14.99	103				
	1991	0.65	0.41-0.93	15.67	104				
	1992	3.36	2.16-5.01	10.90	104				
	1993	0.90	0.53-1.35	16.67	104				
	1994	0.39	0.21-0.59	21.36	104				
	1995	0.54	0.29-0.83	20.37	104				
	1996	0.21	0.09-0.35	28.00	104				
	1997	0.50	0.27-0.75	19.83	79				
prelim.	1998	0.74	0.18-1.55	34.80	22				

Table 17. Bay-River (BRI) juvenile abundance indices for striped bass. Values are given for the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from fixed stations of the tributaries only.

Species	Year	BAY & RIVERS SURVEY				RIVERS ONLY SURVEY			
		Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Striped Bass YOY	1979								
	1980								
	1981								
	1982					0.37	0-1.02	62.37	7
	1983					1.41	0.13-4.12	42.83	27
	1984					0.75	0.36-1.24	22.31	34
	1985					0.54	0.24-0.92	25.05	32
	1986					0.17	0-0.42	61.65	33
	1987		Index based on River data only			3.63	1.88-6.44	15.53	20
	1988					1.93	0.96-3.36	18.56	35
	1989					1.59	0.81-2.7	18.72	37
	1990					1.14	0.5-2.06	23.41	36
	1991					1.02	0.52-1.68	20.27	36
	1992					2.15	1.3-3.32	13.74	39
	1993					3.30	1.93-5.31	13.16	41
	1994					1.07	0.59-1.69	18.11	39
	1995					1.22	0.55-2.17	22.48	39
	1996					1.19	0.66-1.88	17.69	40
	1997					0.41	0.18-0.69	25.98	39
	1998					1.30	0.63-2.25	20.67	38

Table 18. Bay-River (BRI) abundance indices for white perch. Values are given for both YOY and Age 1+ components. These indices are based the River Survey only. '*' indicates a revision from last segment. These indices are calculated from fixed stations of the tributaries only.

Species	Year	YOY				AGE 1+			
		Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
White perch	1979					3.30	1.96-5.24	12.79	16
	1980	No fixed station data for the temporal component				15.79	9.14-26.79	8.93	16
	1981					18.88	10.8-32.49	8.72	17
	1982	1.22	0-9.91	100.00	7	15.88	9.6-25.88	8.23	25
	1983	9.96	4.49-20.91	14.46	27	26.63	14.73-47.53	8.49	44
	1984	13.26	5.68-29.43	14.26	34	23.84	13.52-41.5	8.36	54
	1985	1.86	0.8-3.55	22.09	32	36.76	20.64-64.9	7.67	32
	1986	1.77	0.82-3.22	20.67	33	9.55	5.56-15.97	10.09	51
	1987	42.13	25.07-70.35	6.69	20	21.88	12.58-37.55	8.33	36
	1988	5.29	2.31-10.93	17.43	35	35.10	21.61-56.65	6.53	46
	1989	13.33	7.23-23.97	10.42	37	25.86	15.4-42.99	7.50	46
	1990	3.31	1.56-6.26	17.84	36	31.97	20.13-50.43	6.36	45
	1991	2.30	0.93-4.66	22.53	36	29.49	20.36-42.53	5.21	44
	1992	1.21	0.48-2.31	25.46	39	15.77	9.55-25.66	8.22	48
	1993	17.91	11.93-26.66	6.47	41	15.04	9.79-22.85	7.15	50
	1994	8.43	4-16.77	14.12	39	18.77	10.44-33.15	9.16	48
	1995	4.61	2.45-8.13	14.12	39	40.82	24.11-68.64	6.83	48
	1996	21.61	12.68-36.36	8.05	40	12.78	8.32-19.36	7.45	50
	1997	10.00	6.24-15.72	8.72	39	20.25	12.74-31.86	7.13	52
	1998	7.19	3.25-14.81	15.63	38	28.64	17.62-46.18	6.86	51

Table 19. Bay-River (BRI) abundance indices for white catfish. Values are given for both YOY and Age 1+ components. These indices are based the River Survey only. '*' indicates a revision from last segment. These indices are calculated from fixed stations of the tributaries only.

Species	Year	YOY				AGE 1+			
		Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
White catfish	1979								
	1980	No fixed station data for the temporal component							
	1981								
	1982								
	1983	1.31	0.75-2.05	16.52	49	1.46	0.87-2.24	15.22	49
	1984	1.39	0.77-2.22	17.15	54	3.53	2.14-5.53	12.15	54
	1985	0.14	0.02-0.28	41.84	42	2.14	1.13-3.64	16.96	42
	1986	0.67	0.26-1.21	27.57	44	2.13	1.26-3.33	14.22	44
	1987	1.51	0.32-3.76	34.80	27	2.18	1.01-4.05	19.92	27
	1988	0.61	0.26-1.05	25.44	52	3.16	1.82-5.12	13.59	52
	1989	3.33	1.95-5.36	13.10	52	4.35	2.58-6.99	11.95	52
	1990	0.82	0.36-1.45	24.48	52	6.75	3.94-11.14	10.98	52
	1991	0.19	0.06-0.34	34.23	52	2.31	1.35-3.65	14.28	52
	1992	0.50	0.21-0.86	26.24	52	3.97	2.45-6.15	11.35	52
	1993	1.14	0.61-1.84	18.70	52	1.66	0.89-2.76	17.55	52
	1994	0.34	0.17-0.55	24.03	52	2.72	1.62-4.27	13.28	52
	1995	0.46	0.19-0.8	26.86	52	1.77	1.02-2.8	15.53	52
	1996	1.18	0.62-1.93	18.87	53	3.11	2.04-4.56	10.69	53
	1997	0.94	0.54-1.45	17.61	52	3.45	2.16-5.26	11.43	52
	1998	0.34	0.14-0.57	27.19	51	2.39	1.48-3.62	12.78	51

Table 20. Bay-River (BRI) abundance indices for channel catfish. Values are given for both YOY and Age 1+ components. These indices are based the River Survey only. '*' indicates a revision from last segment. These indices are calculated from fixed stations of the tributaries only.

Species	Year	YOY				AGE 1+			
		Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Channel catfish	1979								
	1980	No fixed station data for the temporal component							
	1981								
	1982								
	1983	0.16	0.03-0.31	39.86	49	0.91	0.43-1.55	22.41	49
	1984	0.43	0.2-0.71	24.76	54	1.69	0.91-2.79	17.33	54
	1985	0.04	0-0.14	100.00	42	1.81	0.97-3.01	17.24	42
	1986	0.08	0-0.19	61.80	44	0.84	0.36-1.49	24.68	44
	1987	0.15	0-0.43	74.64	27	0.85	0.25-1.73	31.61	27
	1988	0.03	0-0.08	74.12	52	0.91	0.42-1.59	23.21	52
	1989	1.27	0.54-2.34	23.71	52	1.20	0.67-1.91	17.62	52
	1990	0.09	0-0.2	57.75	52	1.52	0.7-2.73	21.30	52
	1991	0.02	0-0.07	100.00	52	1.73	0.86-3.01	19.08	52
	1992	0.00	0.00	.	52	1.48	0.69-2.64	21.22	52
	1993	0.08	0-0.17	55.05	52	1.15	0.51-2.06	22.96	52
	1994	0.09	0-0.21	53.98	52	1.49	0.73-2.59	19.95	52
	1995	0.40	0.15-0.7	29.46	52	0.58	0.19-1.1	30.76	52
	1996	0.24	0.07-0.43	33.37	53	1.17	0.61-1.92	19.28	53
	1997	0.03	0-0.08	76.81	52	1.06	0.51-1.8	21.43	52
	1998	0.04	0-0.10	64.15	51	0.71	0.27-1.31	27.90	51

Table 21. Bay-River (BRI) juvenile abundance indices for northern puffer. Values are given for both the Bay and River surveys (BRI) combined, as well as the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from bay data and fixed stations of the tributaries only.

Species	Year	BAY & RIVERS SURVEY Geo. Mean	95% C. I.'s	C.V.	N	RIVERS ONLY SURVEY Geo. Mean	95% C.I.'s	C.V.	N
Northern Puffer	1979								
	1980								
	1981								
	1982	Bay data not collected in similar manner							
	1983								
	1984								
	1985								
	1986								
	1987					Index based on Bay data only.			
	1988	0.84	0.58-1.15	12.43	147				
	1989	0.79	0.61-0.99	9.00	168				
	1990	0.68	0.49-0.9	11.81	167				
	1991	0.45	0.32-0.59	12.78	155				
	1992	0.11	0.06-0.17	22.68	156				
	1993	0.17	0.1-0.24	18.28	156				
	1994	0.10	0.05-0.16	26.01	156				
	1995	0.08	0.04-0.12	24.11	156				
	1996	0.14	0.08-0.22	22.94	156				
	1997	0.20	0.12-0.28	18.18	156				
	1998	0.09	0.04-0.14	27.44	118				

Table 22. Bay-River (BRI) juvenile abundance indices for silver perch. Values are given for both the Bay and River surveys (BRI) combined, as well as the River Survey alone. '*' indicates a revision from last segment. These indices are calculated from bay data and fixed stations of the tributaries only.

		BAY & RIVERS SURVEY				RIVERS ONLY SURVEY			
Species	Year	Geo. Mean	95% C. I.'s	C.V.	N	Geo. Mean	95% C.I.'s	C.V.	N
Silver perch	1979					0.17	0.05-0.3	33.31	95
	1980					0.07	0.01-0.13	43.52	112
	1981					0.06	0.02-0.1	35.02	112
	1982					0.16	0.07-0.26	27.53	114
	1983	Bay data not collected in a similar manner				0.06	0.02-0.1	33.35	113
	1984					0.02	0-0.04	62.18	99
	1985					0.68	0.37-1.06	19.45	59
	1986					0.34	0.19-0.51	20.22	107
	1987					0.53	0.29-0.8	19.53	100
	1988	0.65	0.39-0.96	17.26	172	1.02	0.56-1.62	18.26	65
	1989	0.56	0.36-0.79	15.62	189	1.63	0.91-2.61	16.41	63
	1990	0.75	0.53-0.99	11.81	185	4.08	2.48-6.43	11.69	59
	1991	0.40	0.25-0.56	16.60	179	1.47	0.72-2.54	20.07	62
	1992	0.86	0.55-1.23	14.79	178	1.95	1.33-2.74	10.91	61
	1993	0.45	0.29-0.63	15.54	180	0.60	0.29-0.99	23.07	63
	1994	0.26	0.12-0.41	24.57	180	0.37	0.2-0.56	20.37	63
	1995	0.65	0.4-0.94	16.29	180	1.81	1.12-2.73	13.59	67
	1996	0.58	0.36-0.85	16.61	183	1.18	0.69-1.82	16.37	66
	1997	0.79	0.54-1.08	12.92	192	1.43	0.86-2.18	15.15	75
	1998	0.24	0.15-0.34	18.19	192	0.53	0.33-0.76	16.53	75

Table 23. Converted (RSCI) and unconverted (RSI) indices for spot (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955	1.58	1.27-1.92	6.61	1.48	1.24-1.75	5.65	17			
1956	98.77	50.85-190.95	7.11	37.41	19.41-71.31	8.67	62			
1957	24.87	6.38-89.67	19.28	8.09	2.22-24.68	23.52	47			
1958	7.22	3.41-14.33	14.78	2.86	1.15-5.93	21.62	56			
1959	13.01	5.14-30.97	15.63	3.23	1.11-7.48	24.10	59			
1960	9.30	0.33-78.52	43.83	4.56	0.21-24.55	44.45	27			
1961	8.81	2.03-30.81	25.75	2.76	0.48-8.52	35.07	27			
1962	191.03	30.41-1172.8	17.22	57.43	6.14-476.82	25.83	20			
1963	13.25	1.02-99.35	36.74	5.67	0.48-29.06	39.70	32			
1964	37.85	17.32-81.36	10.27	10.14	4.71-20.73	13.86	54			
1965	2.20	0.86-4.49	23.24	0.96	0.43-1.7	23.69	52			
1966	37.96	15.86-89.01	11.43	17.80	6.34-47.17	16.04	63			
1967	6.02	1.34-20.08	28.22	2.01	0.4-5.45	34.70	88			
1968	143.77	58.12-353.49	9.00	45.03	16.33-121.25	12.75	87			
1969	52.50	25.53-106.89	8.81	19.38	9.56-38.32	10.90	91			
1970	5.59	0.1-38.52	47.51	2.67	0-14.4	55.07	91			
1971	82.09	56.47-119.15	4.17	24.26	16.42-35.63	5.75	265			
1972	98.08	91.85-104.73	0.71	40.46	37.97-43.12	0.83	211			
1973	13.57	9.87-18.53	5.46	11.19	8.26-15.06	5.51	348			
1974	15.62	6.85-34.21	13.35	9.72	4.12-21.44	15.58	243			
1975	33.24	21.82-50.36	5.74	20.90	13.6-31.83	6.56	334			
1976	14.03	10.06-19.42	5.65	7.41	5.36-10.12	6.55	587			
1977	28.75	20.47-40.23	4.81	15.62	11.39-21.31	5.23	530			
1978	9.79	6.4-14.71	7.91	5.54	3.73-8.05	8.64	413			
1979	49.03	42.94-55.95	1.66	25.68	22.39-29.43	2.00	127		17.29	,123
1980	16.46	10.92-24.6	6.68	19.09	13.01-27.83	6.01	158		8.94	,146
1981	31.69	25.22-39.76	3.16	44.59	35.32-56.23	2.98	146		31.06	,137
1982	58.50	30.94-109.84	7.61	76.95	39.99-147.22	7.38	156		36.52	,151
1983	14.99	12.06-18.59	3.65	21.42	17.19-26.65	3.37	151		21.51	,151
1984	41.62	22.86-75.15	7.73	56.84	31.93-100.58	6.94	127		50.28	,132
1985	11.90	6.98-19.84	9.38	15.97	9.46-26.55	8.55	117		19.59	,118
1986	21.07	16.1-27.48	4.12	30.68	23.27-40.35	3.85	144		26.32	,144
1987	8.96	7.1-11.24	4.50	12.96	10.32-16.21	3.97	133		20.45	,133
1988	50.91	35.51-72.8	4.45	67.01	46.36-96.67	4.29	231	67.45	50.20	231,84
1989	22.46	17.7-28.45	3.60	31.41	24.51-40.18	3.44	252	32.27	54.19	252,84
1990	33.88	24.63-46.46	4.34	44.78	32.34-61.85	4.14	248	45.28	53.06	248,81
1991	16.83	12.78-22.08	4.48	16.83	12.78-22.08	4.48	334	16.56	21.44	238,83
1992	2.02	1.54-2.58	7.78	2.02	1.54-2.58	7.78	301	1.96	4.39	238,82
1993	9.99	7.45-13.3	5.48	9.99	7.45-13.3	5.48	300	9.74	11.85	240,84
1994	9.68	7.28-12.79	5.38	9.68	7.28-12.79	5.38	300	9.07	8.88	240,84
1995	1.81	1.39-2.3	7.87	1.81	1.39-2.3	7.87	352	1.52	2.37	240,84
1996	5.26	4.15-6.6	5.30	5.26	4.15-6.6	5.30	407	4.52	4.84	244,88
1997	11.50	9.11-14.45	4.20	11.50	9.11-14.45	4.20	421	8.63	19.68	256,100
1998	2.51	1.92-3.23	7.36	2.51	1.92-3.23	7.36	374	1.88	3.04	214,96

Table 24. Converted (RSCI) and unconverted (RSI) indices for fall Atlantic croaker (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955	.	0.00	.	.	0.00	.	.			
1956	2.68	1.22-5.11	19.41	3.98	1.92-7.52	16.68	27			
1957	3.62	1.54-7.4	19.54	4.04	1.98-7.52	16.26	27			
1958	1.32	0.41-2.81	29.54	1.60	0.5-3.5	28.67	27			
1959	2.14	1.15-3.58	16.52	1.11	0.58-1.82	19.45	18			
1960	.	0.00	.	.	0.00	.	.			
1961	1.20	1.02-1.39	5.40	0.77	0.67-0.88	4.94	15			
1962	0.30	0-1.02	83.36	0.30	0-1.02	83.36	12			
1963	0.72	0.06-1.8	45.00	0.81	0.07-2.04	44.14	17			
1964	0.67	0.32-1.11	22.99	0.67	0.33-1.11	22.59	27			
1965	2.17	1.16-3.67	16.71	1.66	0.95-2.64	15.97	43			
1966	2.00	1.13-3.25	15.73	1.91	1.09-3.05	15.54	42			
1967	0.04	0-0.11	100.00	0.02	0-0.06	100.00	60			
1968	2.10	0.57-5.12	30.01	1.45	0.39-3.32	31.69	60			
1969	27.98	18.79-41.44	5.67	12.75	8.63-18.65	6.80	63			
1970	3.40	1.74-6.05	15.97	1.96	1.03-3.32	17.38	61			
1971	4.70	2.85-7.44	11.29	2.45	1.55-3.68	12.31	177			
1972	6.10	4.59-8.02	6.11	4.94	3.69-6.52	6.63	188			
1973	5.88	4.1-8.27	7.75	3.89	2.69-5.47	8.82	116			
1974	0.87	0.54-1.27	15.46	0.87	0.54-1.27	15.46	44			
1975	7.64	4.82-11.83	9.15	7.64	4.82-11.83	9.15	36			
1976	5.80	3.6-9.05	10.18	9.09	5.57-14.48	9.26	68			
1977	2.97	1.89-4.45	11.49	2.97	1.89-4.45	11.49	52			
1978	6.91	5.32-8.89	5.41	5.17	3.97-6.66	5.93	128			
1979	5.37	3.9-7.27	7.06	3.86	2.81-5.19	7.65	100		4.69	/ 63
1980	3.35	2.33-4.67	9.05	2.01	1.43-2.74	9.76	117		2.53	/ 70
1981	4.78	3.3-6.77	8.44	3.52	2.43-4.96	9.16	122		2.86	/ 75
1982	6.19	4.64-8.15	6.13	4.93	3.72-6.45	6.42	114		3.20	/ 102
1983	8.11	5.24-12.3	8.56	6.37	4.24-9.36	8.52	102		7.32	/ 103
1984	54.69	41.51-71.95	3.36	39.91	30.2-52.64	3.65	83		45.77	/ 86
1985	89.77	72.21-111.54	2.38	71.76	56.56-90.97	2.73	57		74.98	/ 57
1986	20.53	13.76-30.4	6.15	15.94	10.5-23.97	6.85	94		12.63	/ 94
1987	7.21	4.87-10.49	7.98	5.47	3.77-7.76	8.14	68		6.49	/ 68
1988	9.35	5.76-14.84	9.11	7.46	4.68-11.6	9.33	65		9.05	/ 65
1989	60.27	35.47-101.95	6.30	45.95	27.78-75.59	6.36	65		64.78	/ 65
1990	11.68	7.8-17.28	7.20	9.41	6.36-13.74	7.42	60		13.15	/ 60
1991	5.71	3.94-8.1	8.02	5.71	3.94-8.1	8.02	132		9.57	/ 63
1992	10.54	6.95-15.75	7.62	10.54	6.95-15.75	7.62	112		14.59	/ 67
1993	4.54	2.84-7	10.72	4.54	2.84-7	10.72	113		5.42	/ 69
1994	10.45	6.7-16.04	8.15	10.45	6.7-16.04	8.15	112		13.48	/ 67
1995	12.75	9.61-16.81	4.94	12.75	9.61-16.81	4.94	180		11.79	/ 69
1996	32.46	20.05-52.17	6.60	32.46	20.05-52.17	6.60	191		31.06	/ 69
1997	7.94	5.08-12.12	8.77	7.94	5.08-12.12	8.77	199		10.41	/ 75
1998	24.15	16.74-34.65	5.41	24.15	16.74-34.65	5.41	199		21.26	/ 75

Table 25. Converted (RSCI) and unconverted (RSI) indices for spring Atlantic croaker (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955	0.31	0.17-0.45	20.15	0.45	0.3-0.61	14.47	20			
1956	3.28	1.2-7.3	22.81	4.92	2.05-10.48	18.66	48			
1957	13.62	0.11-191.83	48.08	11.70	0.15-139.59	47.30	28			
1958	0.30	0-0.88	71.25	0.40	0-1.22	68.83	59			
1959	0.04	0-0.08	46.61	0.04	0.01-0.07	41.19	48			
1960	0.24	0-0.6	57.76	0.35	0-0.97	62.28	54			
1961	0.36	0-1.05	67.92	0.24	0-0.62	63.83	28			
1962	0.79	0.56-1.05	11.74	0.67	0.47-0.91	12.66	28			
1963	0.01	0-0.04	86.67	0.01	0-0.03	70.15	28			
1964	0.35	0.16-0.57	25.21	0.32	0.18-0.48	20.50	55			
1965	4.01	1.98-7.4	16.06	2.93	1.58-4.98	15.33	48			
1966	-0.00	0-0.01	-332.05	0.00	0-0.01	100.00	66			
1967	0.34	0.19-0.5	19.83	0.26	0.15-0.38	19.42	83			
1968	0.11	0.03-0.2	35.79	0.07	0.02-0.14	39.09	87			
1969	0.26	0.15-0.39	20.62	0.18	0.1-0.26	21.44	91			
1970	0.06	0-0.12	52.38	0.03	0-0.06	49.09	92			
1971	0.23	0.12-0.34	21.94	0.15	0.08-0.24	24.38	228			
1972	4.37	0-31.89	53.90	3.63	0-24.42	55.62	210			
1973	0.12	0.09-0.16	14.60	0.09	0.07-0.13	14.98	417			
1974	2.04	1.2-3.19	14.45	1.68	1.03-2.54	14.09	241			
1975	2.63	1.64-3.98	12.28	2.00	1.29-2.94	12.40	334			
1976	1.08	0.84-1.37	8.65	0.78	0.6-0.97	9.00	591			
1977	0.15	0.1-0.2	16.42	0.11	0.06-0.15	20.39	530			
1978	0.08	0.05-0.11	16.61	0.05	0.03-0.07	17.94	413			
1979	2.18	1.44-3.14	11.43	1.30	0.9-1.79	11.44	119			
1980	0.52	0.39-0.66	10.98	0.44	0.34-0.55	10.12	152			
1981	0.07	0.04-0.1	19.67	0.07	0.04-0.1	20.36	140			
1982	0.11	0.07-0.14	14.68	0.11	0.07-0.14	15.05	168			
1983	6.59	4.94-8.71	6.06	6.67	4.98-8.84	6.10	156			
1984	1.63	0.83-2.77	18.72	1.61	0.83-2.73	18.59	140			
1985	4.98	4.18-5.92	4.05	5.33	4.4-6.42	4.31	106			
1986	2.97	2.25-3.84	7.18	3.33	2.52-4.32	7.03	142			
1987	4.24	3.47-5.14	4.81	4.24	3.47-5.14	4.80	139			
1988	0.32	0.21-0.44	15.52	0.36	0.23-0.49	16.05	234	0.38		234 /
1989	0.60	0.38-0.85	15.51	0.65	0.41-0.93	15.63	252	0.78		252 /
1990	0.43	0.23-0.67	21.19	0.48	0.26-0.74	20.56	252	0.52		252 /
1991	4.41	3.08-6.18	8.36	4.41	3.08-6.18	8.36	307	4.35		238 /
1992	1.28	0.87-1.78	12.10	1.28	0.87-1.78	12.10	309	1.34		240 /
1993	2.17	1.5-3.02	10.34	2.17	1.5-3.02	10.34	301	2.21		240 /
1994	0.90	0.6-1.26	13.54	0.90	0.6-1.26	13.54	300	0.95		240 /
1995	1.06	0.77-1.39	10.40	1.06	0.77-1.39	10.40	306	0.93		246 /
1996	0.19	0.11-0.28	19.63	0.19	0.11-0.28	19.63	405	0.16		242 /
1997	1.47	1.15-1.85	7.78	1.47	1.15-1.85	7.78	419	0.87		255 /
1998	1.19	0.95-1.47	7.51	1.19	0.95-1.47	7.51	374	0.48		214 /

Table 26. Converted (RSCI) and unconverted (RSI) indices for weakfish (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955	2.35	0.00	.	3.07	0.00	.	4			
1956	24.49	10.4-56.02	12.43	39.89	17.24-90.67	10.88	47			
1957	23.10	13.45-39.19	8.03	29.32	19.76-43.28	5.55	43			
1958	1.13	0.36-2.32	29.56	2.12	0.91-4.1	21.62	43			
1959	18.34	8.33-39.11	12.31	10.10	1.47-48.79	31.19	42			
1960	1.38	0.76-2.21	17.25	1.91	1.14-2.96	14.45	13			
1961	1.77	0.32-4.81	36.44	3.12	0.79-8.47	29.39	20			
1962	3.58	2.86-4.43	5.59	3.59	2.87-4.44	5.58	13			
1963	6.50	0-88.61	61.56	9.12	0-188.19	63.23	24			
1964	23.60	7.08-73.94	17.39	21.85	6.46-69.03	17.90	39			
1965	4.19	2.74-6.2	9.97	4.47	3.04-6.4	8.91	40			
1966	11.34	3.19-35.34	21.50	11.54	3.61-33.16	19.80	48			
1967	0.49	0.13-0.96	34.48	0.45	0.13-0.86	33.93	66			
1968	6.45	0.81-29.6	35.17	6.97	1.16-28.37	31.41	67			
1969	8.96	3.31-22	18.22	5.02	0.58-21.87	37.22	68			
1970	26.65	24.06-29.51	1.48	18.82	4.93-65.26	20.20	68			
1971	12.10	8.8-16.52	5.64	11.49	6.96-18.61	8.93	183			
1972	0.70	0.58-0.82	6.87	0.51	0.41-0.61	8.06	157			
1973	1.75	1.2-2.43	10.90	1.05	0.71-1.46	12.59	267			
1974	0.31	0.28-0.34	3.73	0.25	0.23-0.28	3.89	102			
1975	0.20	0.04-0.4	40.21	0.20	0.04-0.4	40.21	54			
1976	1.62	1.14-2.2	10.41	1.79	1.3-2.39	9.49	116			
1977	1.47	0.92-2.17	13.82	1.01	0.71-1.37	11.75	114			
1978	32.94	27.14-39.93	2.66	21.94	17.74-27.07	3.22	91			
1979	22.62	20.09-25.44	1.79	22.63	20.1-25.46	1.79	99		7.18	/ 95
1980	6.45	3.53-11.24	12.39	6.43	3.46-11.36	12.70	120		9.87	/ 111
1981	30.34	12.11-73.89	12.64	31.27	12.12-78.36	12.95	104		6.02	/ 99
1982	17.86	8.98-34.63	10.83	18.41	9.46-35	10.42	116		10.95	/ 113
1983	11.18	8.8-14.15	4.36	10.82	8.45-13.77	4.52	112		10.85	/ 112
1984	4.99	3.26-7.44	9.55	4.73	3.1-7.01	9.60	93		6.05	/ 97
1985	30.23	20.04-45.36	5.74	29.23	19.36-43.88	5.79	80		37.04	/ 81
1986	4.95	3.18-7.45	9.86	4.71	3.05-7.05	9.85	108		4.62	/ 108
1987	12.33	9.53-15.88	4.55	12.58	9.83-16.03	4.34	100		17.85	/ 100
1988	8.05	5.31-11.96	8.17	8.13	5.37-12.07	8.12	173	8.89	21.72	173 / 63
1989	11.91	8.33-16.86	6.34	11.74	8.18-16.68	6.44	189	12.22	21.27	189 / 63
1990	4.29	2.99-6.03	8.52	4.46	3.1-6.26	8.44	184	4.87	30.01	184 / 59
1991	3.21	2.38-4.25	7.64	3.21	2.38-4.25	7.64	252	3.56	15.32	179 / 62
1992	6.78	4.79-9.47	7.21	6.78	4.79-9.47	7.21	226	6.93	15.91	178 / 61
1993	5.84	4.12-8.15	7.55	5.84	4.12-8.15	7.55	225	6.12	15.42	180 / 63
1994	2.60	1.84-3.55	9.21	2.60	1.84-3.55	9.21	225	2.67	7.04	180 / 63
1995	6.62	4.89-8.86	6.34	6.62	4.89-8.86	6.34	275	6.07	11.00	186 / 69
1996	7.26	5.33-9.78	6.31	7.26	5.33-9.78	6.31	305	7.85	7.42	183 / 66
1997	6.81	5.26-8.74	5.38	6.81	5.26-8.74	5.38	316	7.15	14.82	192 / 75
1998	7.60	5.46-10.45	6.65	7.60	5.46-10.45	6.65	269	8.18	9.95	150 / 71

Table 27. Converted (RSCI) and unconverted (RSI) indices for summer flounder (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955	0.00	0.00	.	0.00	0.00	.	2			
1956	4.44	2.91-6.56	9.76	1.29	0.75-2	16.26	29			
1957	2.14	1.22-3.42	15.07	0.69	0.46-0.96	13.88	28			
1958	1.48	0.23-4	38.64	0.42	0.09-0.85	38.03	27			
1959	0.06	0-0.16	75.33	0.03	0-0.06	66.23	27			
1960	.	0.00	.	.	0.00	.	.			
1961	0.19	0-0.61	85.91	0.01	0-0.03	100.00	11			
1962	0.00	0.00	.	0.00	0.00	.	7			
1963	2.07	0.78-4.29	24.24	1.09	0.43-2.05	25.73	12			
1964	0.65	0.55-0.77	6.77	0.39	0.25-0.54	16.05	16			
1965	0.74	0.27-1.39	28.63	0.45	0.16-0.82	30.37	13			
1966	0.00	0.00	.	0.00	0.00	.	17			
1967	0.43	0-1.46	76.12	0.26	0-0.78	74.97	27			
1968	0.14	0-0.37	67.30	0.10	0-0.26	66.24	27			
1969	0.19	0.03-0.37	41.25	0.13	0.02-0.25	40.27	27			
1970	0.03	0-0.07	79.32	0.02	0-0.06	82.08	29			
1971	3.71	3.41-4.03	2.10	2.05	1.9-2.22	2.38	129			
1972	0.85	0.79-0.92	2.72	0.80	0.77-0.82	1.31	84			
1973	1.27	0.77-1.89	14.97	0.99	0.62-1.46	15.20	94			
1974	0.82	0.31-1.51	27.15	0.82	0.31-1.51	27.15	32			
1975	0.14	0-0.3	51.20	0.14	0-0.3	51.20	22			
1976	0.57	0.32-0.86	19.17	0.65	0.41-0.93	15.75	68			
1977	1.67	1.16-2.31	10.81	1.67	1.16-2.31	10.81	36			
1978	1.24	0.47-2.4	25.89	1.24	0.47-2.4	25.89	36			
1979	2.94	2.74-3.15	1.88	2.94	2.74-3.15	1.88	50		1.01	/ 48
1980	10.69	6.49-17.25	9.05	10.25	6.24-16.47	9.09	70		7.60	/ 58
1981	3.97	2.39-6.31	12.00	3.91	2.35-6.21	12.04	67		5.10	/ 61
1982	2.27	1.54-3.21	10.66	2.27	1.54-3.21	10.66	64		4.30	/ 60
1983	5.01	3.62-6.82	7.34	5.01	3.62-6.82	7.34	60		5.21	/ 62
1984	1.58	0.96-2.39	14.50	1.58	0.96-2.4	14.46	41		1.90	/ 45
1985	1.26	0.52-2.37	24.41	1.26	0.52-2.37	24.41	27		1.11	/ 27
1986	1.26	0.77-1.89	15.00	1.26	0.77-1.89	15.00	53		1.27	/ 53
1987	0.39	0.2-0.63	23.05	0.39	0.2-0.63	23.05	52		0.45	/ 52
1988	0.54	0.35-0.75	14.99	0.54	0.35-0.75	14.99	143	0.53	0.54	143 / 36
1989	1.24	0.94-1.58	8.77	1.24	0.94-1.58	8.77	162	1.23	0.96	162 / 36
1990	2.54	2.06-3.09	5.73	2.54	2.06-3.09	5.73	162	2.54	2.61	162 / 36
1991	2.81	2.28-3.41	5.51	2.81	2.28-3.41	5.51	207	2.78	1.42	153 / 36
1992	0.92	0.7-1.16	9.09	0.92	0.7-1.16	9.09	187	0.91	0.49	153 / 36
1993	0.52	0.37-0.67	11.77	0.52	0.37-0.67	11.77	185	0.53	0.49	153 / 36
1994	2.50	1.99-3.1	6.30	2.50	1.99-3.1	6.30	186	2.50	1.08	153 / 36
1995	0.71	0.53-0.91	10.21	0.71	0.53-0.91	10.21	218	0.72	0.74	149 / 36
1996	0.81	0.62-1.02	9.32	0.81	0.62-1.02	9.32	224	0.86	0.62	153 / 36
1997	0.89	0.69-1.12	8.77	0.89	0.69-1.12	8.77	226	0.97	0.70	153 / 36
1998	0.73	0.55-0.93	9.92	0.73	0.55-0.93	9.92	226	0.78	0.17	153 / 36
1999										

Table 28. Converted (RSCI) and unconverted (RSI) indices for black seabass (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1954	0.11	0-0.36	100.00	0.11	0-0.36	100.00	5			
1955	0.75	0.03-1.95	46.95	0.75	0.03-1.95	46.95	10			
1956	0.15	0.15-0.15	0.00	0.15	0.15-0.15	0.00	5			
1957	0.00	0.00	.	0.00	0.00	.	14			
1958	0.00	0.00	.	0.00	0.00	.	9			
1959	0.16	0-0.34	48.64	0.16	0-0.34	48.64	14			
1960	0.00	0.00	.	0.00	0.00	.	6			
1961	0.48	0-1.66	73.88	0.48	0-1.66	73.88	6			
1962	0.00	0.00	.	0.00	0.00	.	3			
1963	0.83	0-3.85	80.75	0.83	0-3.85	80.75	14			
1964	0.00	0.00	.	0.00	0.00	.	7			
1965	0.29	0-0.78	63.47	0.29	0-0.78	63.47	11			
1966	0.03	0-0.08	100.00	0.03	0-0.08	100.00	13			
1967	0.00	0.00	.	0.00	0.00	.	12			
1968	0.00	0.00	.	0.00	0.00	.	12			
1969	0.23	0-0.74	82.98	0.23	0-0.74	82.98	12			
1970	0.38	0-1.35	81.42	0.38	0-1.35	81.42	14			
1971	0.52	0.45-0.59	5.63	0.52	0.45-0.59	5.63	17			
1972	0.22	0.08-0.37	30.40	0.13	0.05-0.22	30.25	102			
1973	2.31	1.67-3.11	8.98	1.43	1.06-1.87	9.38	93			
1974	0.89	0.49-1.39	18.60	0.55	0.32-0.83	18.77	96			
1975	0.40	0.23-0.6	19.23	0.26	0.15-0.38	19.34	201			
1976	1.57	1.13-2.1	9.88	0.91	0.64-1.21	11.51	182			
1977	0.23	0.08-0.41	31.94	0.14	0.05-0.25	31.82	160			
1978	2.75	0.35-9.41	38.61	2.75	0.35-9.41	38.61	16			
1979	0.11	0-0.24	56.90	0.11	0-0.24	56.90	34		0.86	/ 16
1980	1.48	0.87-2.31	15.73	1.48	0.87-2.31	15.73	31		0.15	/ 23
1981	0.29	0.14-0.45	23.47	0.29	0.14-0.45	23.47	42		0.31	/ 23
1982	0.46	0.16-0.83	30.13	0.46	0.16-0.83	30.13	25		0.30	/ 22
1983	0.67	0.12-1.49	38.63	0.67	0.12-1.49	38.63	16		0.40	/ 25
1984	1.29	0.63-2.21	20.63	1.29	0.63-2.21	20.63	12		0.44	/ 16
1985	2.04	0.95-3.75	20.01	2.04	0.95-3.75	20.01	18		0.73	/ 12
1986	0.61	0.39-0.88	15.68	0.61	0.39-0.88	15.68	18		1.19	/ 18
1987	1.58	1.08-2.2	11.43	1.58	1.08-2.2	11.43	124		0.27	124 / 12
1988	0.84	0.59-1.13	11.89	0.84	0.59-1.13	11.89	138	1.58	0.95	138 / 12
1989	2.36	1.7-3.17	8.93	2.36	1.7-3.17	8.93	138	0.83	1.04	138 / 12
1990	1.12	0.78-1.53	11.63	1.12	0.78-1.53	11.63	128	2.36	1.52	128 / 12
1991	1.28	0.91-1.72	10.76	1.28	0.91-1.72	10.76	129	1.12	0.50	129 / 12
1992	0.22	0.13-0.32	18.86	0.22	0.13-0.32	18.86	129	1.29	2.35	129 / 12
1993	1.05	0.74-1.42	11.46	1.05	0.74-1.42	11.46	129	0.22	0.19	129 / 12
1994	1.06	0.74-1.45	11.85	1.06	0.74-1.45	11.85	129	1.04	0.76	129 / 12
1995	0.50	0.33-0.69	14.47	0.50	0.33-0.69	14.47	151	1.06	0.60	127 / 12
1996	0.36	0.22-0.52	17.99	0.36	0.22-0.52	17.99	152	0.54	0.62	128 / 12
1997	0.46	0.31-0.63	14.63	0.46	0.31-0.63	14.63	153	0.35	0.38	129 / 12
1998*	0.64	0.37-0.97	18.23	0.64	0.37-0.97	18.23	91	0.47	0.23	74 / 8

Table 29. Converted (RSCI) and unconverted (RSI) indices for scup (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1954	0.00	0.00	.	0.00	0.00	.	5			
1955	1.44	0.72-2.46	19.55	1.44	0.72-2.46	19.55	18			
1956	2.17	1.02-3.98	19.50	2.17	1.02-3.98	19.50	15			
1957	0.07	0-0.14	49.70	0.07	0-0.14	49.70	19			
1958	0.01	0-0.03	100.00	0.01	0-0.03	100.00	19			
1959	1.21	0.23-2.98	36.97	1.21	0.23-2.98	36.97	14			
1960	2.15	0.18-7.39	42.80	2.15	0.18-7.39	42.80	7			
1961	0.75	0-4.36	100.00	0.75	0-4.36	100.00	6			
1962	38.44	15.14-95.36	12.15	38.44	15.14-95.36	12.15	6			
1963	0.70	0-3.95	100.00	0.70	0-3.95	100.00	9			
1964							0			
1965	3.54	0.67-11.34	33.06	3.54	0.67-11.34	33.06	8			
1966	0.00	0.00	.	0.00	0.00	.	8			
1967	0.52	0.11-1.1	38.14	0.52	0.11-1.1	38.14	8			
1968	0.96	0-3.56	62.53	0.96	0-3.56	62.53	8			
1969	0.25	0-0.64	59.29	0.25	0-0.64	59.29	8			
1970	0.08	0-0.2	68.09	0.08	0-0.2	68.09	8			
1971	0.00	0.00	.	0.00	0.00	.	4			
1972	0.00	0.00	.	0.00	0.00	.	58			
1973	4.67	2.8-7.45	11.51	4.67	2.8-7.45	11.51	61			
1974	0.00	0.00	.	0.00	0.00	.	53			
1975	1.78	0.79-3.32	21.52	1.78	0.79-3.32	21.52	70			
1976	0.64	0.25-1.16	27.55	0.64	0.25-1.16	27.55	52			
1977	0.00	0.00	.	0.00	0.00	.	73			
1978	1.65	0-17.52	100.00	1.65	0-17.52	100.00	2			
1979	0.74	0.11-1.72	40.43	0.74	0.11-1.72	40.43	15			
1980	5.60	4.4-7.07	5.31	5.60	4.4-7.07	5.31	6			
1981	0.75	0.21-1.52	32.96	0.75	0.21-1.52	32.96	7			
1982							0			
1983							0			
1984							0			
1985							0			
1986							0			
1987	2.07	1.24-3.21	14.10	2.07	1.24-3.21	14.10	92	2.07		92 /
1988	3.06	2.05-4.41	10.20	3.06	2.05-4.41	10.20	112	3.06		112 /
1989	4.92	3.14-7.45	10.03	4.92	3.14-7.45	10.03	112	4.92		112 /
1990	1.90	1.11-2.99	14.99	1.90	1.11-2.99	14.99	103	1.90		103 /
1991	0.65	0.41-0.93	15.67	0.65	0.41-0.93	15.67	104	0.65		104 /
1992	3.36	2.16-5.01	10.90	3.36	2.16-5.01	10.90	104	3.36		104 /
1993	0.90	0.53-1.35	16.67	0.90	0.53-1.35	16.67	104	0.90		104 /
1994	0.39	0.21-0.59	21.36	0.39	0.21-0.59	21.36	104	0.39		104 /
1995	0.54	0.29-0.83	20.37	0.54	0.29-0.83	20.37	104	0.54		104 /
1996	0.21	0.09-0.35	28.00	0.21	0.09-0.35	28.00	104	0.21		104 /
1997	0.50	0.27-0.75	19.83	0.50	0.27-0.75	19.83	79	0.50		79 /
1998*	0.74	0.18-1.55	34.80	0.74	0.18-1.55	34.80	22	0.74		22 /

Table 30. Converted (RSCI) and unconverted (RSI) indices for striped bass (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1954							0			
1955							0			
1956	1.47	0.03-4.95	48.63	1.55	0.06-5.14	46.94	13			
1957	2.75	1.56-4.49	14.45	2.85	1.62-4.68	14.38	15			
1958	6.06	2.02-15.53	21.76	6.53	1.84-18.95	24.14	5			
1959							0			
1960	2.79	1.74-4.25	12.16	2.79	1.74-4.25	12.16	4			
1961	1.98	0.43-5.25	33.78	2.12	0.47-5.63	33.16	9			
1962	1.21	0.27-2.84	35.04	1.21	0.27-2.84	35.04	8			
1963	6.71	4.92-9.03	6.45	7.27	5.23-9.99	6.72	20			
1964	1.25	0.51-2.36	24.62	1.26	0.52-2.38	24.50	23			
1965	3.23	1.19-7.15	22.80	3.29	1.22-7.27	22.58	31			
1966	2.13	1.41-3.07	11.50	2.14	1.41-3.08	11.51	26			
1967	3.10	1.33-6.21	19.98	4.92	2.19-9.96	17.35	26			
1968	1.78	1.16-2.58	12.40	2.92	1.78-4.53	12.54	39			
1969	1.08	0.79-1.42	10.30	1.53	1.01-2.18	12.30	36			
1970	2.04	1.02-3.59	18.48	2.75	1.42-4.8	16.56	35			
1971	0.44	0.26-0.65	18.21	0.72	0.44-1.05	16.24	54			
1972	0.28	0-1.04	96.90	0.28	0-1.04	96.90	50			
1973	0.08	0.01-0.15	42.86	0.08	0.01-0.15	42.86	49			
1974	0.02	0-0.05	100.00	0.02	0-0.05	100.00	53			
1975	0.21	0.04-0.41	40.02	0.21	0.04-0.41	40.02	53			
1976							0			
1977	0.15	0.05-0.27	32.98	0.15	0.05-0.27	32.98	42			
1978	0.34	0.13-0.58	28.54	0.34	0.14-0.58	28.36	109			
1979	0.17	0.04-0.32	36.64	0.17	0.04-0.32	36.64	43			
1980	0.42	0.18-0.71	26.35	0.42	0.18-0.71	26.35	48			
1981	1.31	0.5-2.56	25.80	1.33	0.51-2.59	25.63	51			
1982	0.79	0.11-1.9	41.36	0.79	0.11-1.9	41.36	38		0.37	/ 7
1983	1.50	0.36-3.57	33.01	1.50	0.36-3.57	33.01	25		1.41	/ 27
1984	0.43	0.25-0.64	19.16	0.43	0.25-0.64	19.16	33		0.75	/ 34
1985	0.53	0.04-1.24	44.90	0.53	0.04-1.24	44.90	32		0.54	/ 32
1986	0.08	0-0.19	59.02	0.08	0-0.19	59.02	33		0.17	/ 33
1987	3.34	1.82-5.68	14.71	3.34	1.82-5.68	14.71	21		3.63	/ 20
1988	1.24	0.65-2.06	19.19	1.24	0.65-2.06	19.19	35		1.93	/ 35
1989	1.65	1.12-2.32	11.51	1.65	1.12-2.32	11.51	37		1.59	/ 37
1990	1.06	0.49-1.84	22.33	1.06	0.49-1.84	22.33	36		1.14	/ 36
1991	0.97	0.29-2	31.00	0.97	0.29-2	31.00	51		1.02	/ 36
1992	1.28	0.83-1.83	13.18	1.28	0.83-1.83	13.18	51		2.15	/ 39
1993	2.69	1.23-5.1	19.32	2.69	1.23-5.1	19.32	53		3.30	/ 41
1994	1.33	0.88-1.88	12.58	1.33	0.88-1.88	12.58	51		1.07	/ 39
1995	0.61	0.33-0.96	20.19	0.61	0.33-0.96	20.19	75		1.22	/ 39
1996	0.61	0.32-0.95	20.56	0.61	0.32-0.95	20.56	90		1.19	/ 40
1997	0.55	0.25-0.93	24.75	0.55	0.25-0.93	24.75	90		0.41	/ 39
1998	0.85	0.43-1.4	20.91	0.85	0.43-1.4	20.91	90		1.30	/ 38

Table 31. Converted (RSCI) and unconverted (RSI) indices for y-o-y white perch (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955							0			
1956	3.48	1.78-6.22	15.90	3.48	1.78-6.22	15.90	13			
1957	15.46	9.07-25.91	8.77	15.46	9.07-25.91	8.77	15			
1958	39.04	13.84-107.07	13.45	39.04	13.84-107.07	13.45	5			
1959							0			
1960	0.00	0.00	.	0.00	0.00	.	4			
1961	2.72	0.3-9.63	39.91	2.72	0.3-9.63	39.91	9			
1962	3.75	0.09-19.66	47.15	3.75	0.09-19.66	47.15	8			
1963	19.57	11.86-31.92	7.77	19.57	11.86-31.92	7.77	20			
1964	7.60	4.57-12.27	10.10	7.60	4.57-12.27	10.10	23			
1965	0.70	0.2-1.42	32.95	0.70	0.2-1.42	32.95	31			
1966	9.32	4.73-17.59	12.61	9.32	4.73-17.59	12.61	26			
1967	9.56	5.11-17.25	11.61	9.56	5.11-17.25	11.61	26			
1968	1.66	0.89-2.75	17.45	1.66	0.89-2.75	17.45	39			
1969	4.63	2.46-8.16	14.07	4.63	2.46-8.16	14.07	36			
1970	13.86	6.42-28.75	12.86	13.86	6.42-28.75	12.86	35			
1971	2.47	1.36-4.08	15.42	2.31	1.27-3.83	15.79	54			
1972	1.77	0.76-3.36	22.29	1.24	0.54-2.25	23.04	50			
1973	2.33	1.56-3.33	10.93	1.78	1.18-2.55	11.97	49			
1974	0.78	0.52-1.09	13.73	0.58	0.38-0.81	14.70	53			
1975	1.52	0.81-2.49	17.76	1.03	0.56-1.65	18.76	53			
1976							0			
1977	4.34	2.4-7.4	13.49	2.84	1.6-4.68	14.52	42			
1978	14.22	9.62-20.83	6.62	9.11	6.17-13.26	7.43	109			
1979	9.00	5.73-13.84	8.58	5.59	3.53-8.57	9.90	43			
1980	0.45	0.2-0.74	24.97	0.45	0.2-0.74	24.97	48			
1981	1.01	0.65-1.44	13.98	1.01	0.65-1.44	13.98	51			
1982	4.53	1.53-11.09	22.89	4.53	1.53-11.09	22.89	38		1.22	/ 7
1983	8.61	3.95-17.67	14.66	8.61	3.95-17.67	14.66	25		9.96	/ 27
1984	23.80	14.97-37.53	6.86	23.80	14.97-37.53	6.86	33		13.26	/ 34
1985	2.07	1.23-3.24	14.30	2.07	1.23-3.24	14.30	32		1.86	/ 32
1986	2.81	1.83-4.12	11.12	2.81	1.83-4.12	11.12	33		1.77	/ 33
1987	33.58	18.74-59.57	7.91	42.47	24.73-72.42	6.95	21		42.13	/ 20
1988	6.15	3.68-9.91	10.75	6.15	3.68-9.91	10.75	35		5.29	/ 35
1989	12.93	6.69-24.25	11.29	12.93	6.69-24.25	11.29	37		13.33	/ 37
1990	3.24	1.84-5.32	13.89	3.23	1.84-5.32	13.89	36		3.31	/ 36
1991	3.40	1.17-7.94	23.89	3.40	1.17-7.94	23.89	51		2.30	/ 36
1992	1.54	0.83-2.52	17.56	1.54	0.83-2.52	17.56	51		1.21	/ 39
1993	17.87	5.3-55.51	18.67	17.87	5.3-55.51	18.67	53		17.91	/ 41
1994	12.33	6.84-21.68	10.26	12.33	6.84-21.68	10.26	51		8.43	/ 39
1995	1.92	0.98-3.29	18.01	1.92	0.98-3.29	18.01	75		4.61	/ 39
1996	24.41	12.94-45.29	9.27	24.41	12.94-45.29	9.27	90		21.61	/ 40
1997	9.34	6.04-14.19	8.22	9.34	6.04-14.19	8.22	90		10.00	/ 39
1998	3.76	1.99-6.56	14.85	3.76	1.99-6.56	14.85	90		7.19	/ 38

Table 32. Converted (RSCI) and unconverted (RSI) indices for age 1+ white perch (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955							0			
1956	33.39	13-83.51	12.70	37.61	15.31-90.42	11.79	18			
1957	50.73	20.87-121.39	10.91	55.62	23.38-130.5	10.44	20			
1958	68.94	22.01-211.64	13.09	68.94	22.01-211.64	13.09	10			
1959	6.17	2.73-12.77	16.56	6.17	2.73-12.77	16.56	5			
1960	170.19	36.71-776.2	14.71	170.19	36.71-776.2	14.71	4			
1961	60.68	20.85-173.14	12.59	65.41	23.3-180.44	11.98	12			
1962	70.46	17.97-268.13	15.53	87.59	24.36-308.52	13.95	11			
1963	92.10	39.25-214.34	9.25	101.93	43.68-236.15	9.01	24			
1964	101.05	83.15-122.75	2.08	102.76	84.48-124.93	2.09	27			
1965	32.32	17.11-60.32	8.70	33.64	17.86-62.6	8.57	38			
1966	16.42	9-29.32	9.70	16.42	9-29.32	9.70	35			
1967	26.62	15.12-46.32	8.11	47.08	32.22-68.61	4.78	39			
1968	23.43	11.86-45.4	10.04	42.17	21.89-80.4	8.42	52			
1969	6.49	4.08-10.05	9.65	14.17	9.21-21.53	7.28	50			
1970	11.69	6.67-19.99	9.90	17.48	9.71-30.9	9.36	48			
1971	4.55	3.03-6.65	9.37	6.40	4.26-9.42	8.54	72			
1972	2.64	1.98-3.45	7.75	2.56	1.92-3.34	7.80	85			
1973	3.00	1.94-4.45	11.14	2.71	1.74-4.03	11.57	60			
1974	2.14	1.38-3.15	12.08	1.95	1.27-2.82	12.05	63			
1975	4.22	2.65-6.46	10.82	3.59	2.33-5.34	10.57	63			
1976	7.24	2.8-16.87	18.35	8.41	2.59-23.67	21.49	12			
1977	4.12	2.74-5.99	9.57	3.74	2.56-5.32	9.21	56			
1978	4.83	3.25-6.99	8.96	4.08	2.76-5.86	9.23	123			
1979	15.78	8.45-28.81	10.18	13.46	7.44-23.77	10.08	59		3.30	/ 16
1980	5.80	3.5-9.26	10.75	5.80	3.5-9.27	10.75	64		15.79	/ 16
1981	24.86	15.15-40.42	7.24	24.86	15.15-40.42	7.24	68		18.88	/ 17
1982	28.78	15.09-54.09	9.06	28.78	15.09-54.09	9.06	56		15.88	/ 25
1983	28.86	18.53-44.63	6.25	28.86	18.53-44.63	6.25	44		26.63	/ 44
1984	25.70	12.22-52.95	10.70	25.70	12.22-52.95	10.70	54		23.84	/ 54
1985	33.19	22.39-48.98	5.37	33.19	22.39-48.98	5.37	32		36.76	/ 32
1986	12.06	6.72-21.1	10.23	12.06	6.72-21.1	10.23	51		9.55	/ 51
1987	16.57	9.21-29.22	9.46	18.96	10.49-33.68	9.22	37		21.88	/ 36
1988	39.57	26.69-58.42	5.15	39.57	26.69-58.42	5.15	46		35.10	/ 46
1989	22.78	16-32.25	5.29	22.78	16-32.25	5.29	46		25.86	/ 46
1990	35.39	21.9-56.83	6.44	35.39	21.9-56.84	6.44	45		31.97	/ 45
1991	32.45	23.82-44.09	4.25	32.45	23.82-44.09	4.25	65		29.49	/ 44
1992	11.17	7.47-16.47	7.24	11.17	7.47-16.47	7.24	64		15.77	/ 48
1993	10.11	4.69-20.69	13.90	10.11	4.69-20.69	13.90	66		15.04	/ 50
1994	21.29	13.52-33.2	6.90	21.29	13.52-33.2	6.90	64		18.77	/ 48
1995	10.76	6.53-17.36	9.04	10.76	6.53-17.36	9.04	98		40.82	/ 48
1996	9.03	5.29-15	10.13	9.03	5.29-15	10.13	116		12.78	/ 50
1997	19.37	10.56-34.9	9.40	19.37	10.56-34.9	9.40	120		20.25	/ 52
1998	11.07	6.84-17.57	8.65	11.07	6.84-17.57	8.65	120		28.64	/ 51

Table 33. Converted (RSCI) and unconverted (RSI) indices for y-o-y white catfish (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1954	0.41	0-1.83	100.00	0.41	0-1.83	100.00	2			
1955	0.82	0.54-1.16	14.20	0.82	0.54-1.16	14.20	5			
1956	1.27	0.46-2.53	26.77	1.27	0.46-2.53	26.77	13			
1957	1.26	0.75-1.93	15.84	1.26	0.75-1.93	15.84	20			
1958	3.31	0.23-14.14	43.03	3.31	0.23-14.14	43.03	5			
1959							0			
1960	4.77	0.72-18.41	34.61	4.77	0.72-18.41	34.61	6			
1961	1.33	0.49-2.66	26.62	1.33	0.49-2.66	26.62	12			
1962	0.67	0-1.88	52.77	0.67	0-1.88	52.77	14			
1963	0.22	0.07-0.39	33.61	0.22	0.07-0.39	33.61	24			
1964	0.55	0.23-0.94	26.22	0.55	0.23-0.94	26.22	33			
1965	0.33	0.11-0.59	31.25	0.33	0.11-0.59	31.25	42			
1966	0.55	0.19-1.02	30.41	0.55	0.19-1.02	30.41	43			
1967	0.82	0.28-1.57	29.11	0.82	0.28-1.57	29.11	34			
1968	0.32	0.14-0.52	26.80	0.32	0.14-0.52	26.80	54			
1969	0.49	0.29-0.72	17.91	0.49	0.29-0.72	17.91	50			
1970	0.41	0.07-0.85	40.00	0.41	0.07-0.85	40.00	50			
1971	2.20	1.34-3.37	13.43	2.20	1.34-3.37	13.43	71			
1972	0.05	0-0.12	60.39	0.05	0-0.12	60.39	53			
1973	0.95	0.31-1.89	29.54	0.95	0.31-1.89	29.54	84			
1974	0.38	0.15-0.65	28.08	0.38	0.15-0.65	28.08	53			
1975	1.41	0.87-2.09	14.23	1.46	0.91-2.17	13.99	70			
1976	0.04	0-0.09	57.65	0.04	0-0.09	57.65	39			
1977	0.14	0.03-0.27	40.50	0.14	0.03-0.27	40.50	59			
1978	2.01	1.41-2.76	10.11	2.01	1.41-2.76	10.11	95			
1979	0.32	0.11-0.58	31.53	0.32	0.11-0.58	31.53	54			
1980	0.12	0.02-0.24	41.75	0.12	0.02-0.24	41.75	50			
1981	0.41	0.1-0.81	36.40	0.41	0.1-0.81	36.43	78			
1982	0.06	0.01-0.11	41.56	0.06	0.01-0.11	41.56	41			
1983	2.47	2.17-2.8	3.64	2.47	2.17-2.8	3.64	46		1.31	/ 49
1984	1.11	0.76-1.52	11.93	1.11	0.76-1.52	11.93	54		1.39	/ 54
1985	0.10	0.01-0.2	44.53	0.10	0.01-0.2	44.53	42		0.14	/ 42
1986	0.95	0.64-1.32	12.96	0.95	0.64-1.32	12.96	44		0.67	/ 44
1987	1.77	0.61-3.76	26.61	1.77	0.61-3.76	26.61	28		1.51	/ 27
1988	0.25	0.11-0.41	26.68	0.25	0.11-0.41	26.68	52		0.61	/ 52
1989	3.63	2.01-6.12	14.03	3.63	2.01-6.12	14.03	51		3.33	/ 52
1990	0.76	0.57-0.97	9.89	0.76	0.57-0.97	9.89	52		0.82	/ 52
1991	0.06	0.02-0.11	34.21	0.06	0.02-0.11	34.21	72		0.19	/ 52
1992	0.74	0.57-0.92	9.04	0.74	0.57-0.92	9.04	68		0.50	/ 52
1993	0.80	0.45-1.23	18.34	0.80	0.45-1.23	18.34	68		1.14	/ 52
1994	0.12	0.06-0.19	25.82	0.12	0.06-0.19	25.82	68		0.34	/ 52
1995	0.21	0.08-0.35	29.33	0.21	0.08-0.35	29.33	109		0.46	/ 52
1996	0.36	0.18-0.55	22.23	0.36	0.18-0.55	22.23	120		1.18	/ 53
1997	0.37	0.23-0.53	17.47	0.37	0.23-0.53	17.47	120		0.94	/ 52
1998	0.07	0.04-0.1	22.44	0.07	0.04-0.1	22.44	120		0.34	/ 51

Table 34. Converted (RSCI) and unconverted (RSI) indices for age 1+ white catfish (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1954	0.41	0-1.83	100.00	0.41	0-1.83	100.00	2			
1955	2.12	1.51-2.87	9.54	2.12	1.51-2.87	9.54	5			
1956	1.72	0.81-3.09	20.34	1.72	0.81-3.09	20.34	13			
1957	2.65	1.55-4.21	13.78	2.65	1.55-4.21	13.78	20			
1958	8.43	0.38-63.2	42.75	8.43	0.38-63.2	42.75	5			
1959							0			
1960	9.81	2.31-34.25	24.84	9.81	2.31-34.25	24.84	6			
1961	2.47	1.6-3.63	11.57	2.47	1.6-3.63	11.57	12			
1962	14.14	5.56-33.94	15.40	14.14	5.56-33.94	15.40	14			
1963	1.30	0.67-2.17	19.15	1.30	0.67-2.17	19.15	24			
1964	1.35	0.85-1.98	13.95	1.35	0.85-1.98	13.95	33			
1965	0.69	0.41-1.02	17.00	0.69	0.41-1.02	17.00	42			
1966	1.68	1.1-2.43	12.48	1.68	1.1-2.43	12.48	43			
1967	1.49	0.81-2.41	17.33	1.49	0.81-2.41	17.33	34			
1968	0.64	0.29-1.08	24.04	0.64	0.29-1.08	24.04	54			
1969	0.97	0.57-1.46	16.60	0.97	0.57-1.46	16.60	50			
1970	1.38	0.52-2.72	25.82	1.38	0.52-2.72	25.82	50			
1971	2.12	1.46-2.95	10.47	2.12	1.46-2.95	10.47	71			
1972	1.11	0.49-2.01	23.57	1.11	0.49-2.01	23.57	53			
1973	1.19	0.79-1.67	12.83	1.19	0.79-1.67	12.83	84			
1974	0.71	0.38-1.12	20.24	0.71	0.38-1.12	20.24	53			
1975	0.95	0.64-1.33	13.02	0.94	0.64-1.31	12.96	70			
1976	0.41	0.16-0.71	28.08	0.41	0.16-0.71	28.08	39			
1977	0.50	0.27-0.76	20.28	0.50	0.27-0.76	20.28	59			
1978	0.29	0.14-0.46	24.02	0.29	0.14-0.46	24.02	95			
1979	1.46	0.68-2.59	21.08	1.46	0.68-2.59	21.08	54			
1980	0.54	0.28-0.87	21.91	0.55	0.28-0.88	22.05	50			
1981	1.16	0.7-1.74	15.60	1.16	0.7-1.74	15.59	78			
1982	1.91	0.82-3.65	21.93	1.91	0.82-3.65	21.93	41			
1983	1.62	0.7-3.02	22.30	1.62	0.7-3.02	22.31	46		1.46	/ 49
1984	2.31	1.35-3.67	14.33	2.31	1.35-3.67	14.33	54		3.53	/ 54
1985	2.47	1.02-4.95	21.67	2.47	1.02-4.95	21.67	42		2.14	/ 42
1986	1.77	1.31-2.33	8.99	1.77	1.31-2.33	8.99	44		2.13	/ 44
1987	1.71	0.98-2.71	15.74	1.71	0.98-2.71	15.74	28		2.18	/ 27
1988	1.88	1.29-2.62	10.81	1.88	1.29-2.62	10.81	52		3.16	/ 52
1989	3.23	1.68-5.67	15.78	3.23	1.68-5.67	15.78	51		4.35	/ 52
1990	3.46	2.13-5.34	11.82	3.46	2.13-5.34	11.82	52		6.75	/ 52
1991	2.04	0.9-3.87	21.14	2.04	0.9-3.87	21.14	72		2.31	/ 52
1992	3.77	3.03-4.63	5.34	3.77	3.03-4.63	5.34	68		3.97	/ 52
1993	2.25	1.19-3.82	16.69	2.25	1.19-3.82	16.69	68		1.66	/ 52
1994	1.59	1.09-2.22	11.37	1.59	1.09-2.22	11.37	68		2.72	/ 52
1995	0.94	0.45-1.61	22.21	0.94	0.45-1.61	22.21	109		1.77	/ 52
1996	1.05	0.76-1.4	10.78	1.05	0.76-1.4	10.78	120		3.11	/ 53
1997	1.85	1.32-2.49	9.82	1.85	1.32-2.49	9.82	120		3.45	/ 52
1998	1.34	0.82-2	14.64	1.34	0.82-2	14.64	120		2.39	/ 51

Table 35. Converted (RSCI) and unconverted (RSI) indices for y-o-y channel catfish (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1954	0.00	0.00	.	0.00	0.00	.	2			
1955	0.08	0-0.25	100.00	0.08	0-0.25	100.00	5			
1956	0.03	0-0.1	100.00	0.03	0-0.1	100.00	13			
1957	0.09	0.01-0.17	44.17	0.09	0.01-0.17	44.17	20			
1958	0.00	0.00	.	0.00	0.00	.	5			
1959							0			
1960	0.00	0.00	.	0.00	0.00	.	6			
1961	0.46	0.06-1	42.06	0.46	0.06-1	42.06	12			
1962	0.19	0-0.48	63.03	0.19	0-0.48	63.03	14			
1963	0.87	0-4.83	90.76	0.87	0-4.83	90.76	24			
1964	0.34	0.08-0.66	36.52	0.34	0.08-0.66	36.52	33			
1965	0.29	0.06-0.58	38.23	0.29	0.06-0.58	38.23	42			
1966	1.48	0.71-2.6	20.44	1.48	0.71-2.6	20.44	43			
1967	0.12	0-0.33	74.16	0.12	0-0.33	74.16	34			
1968	0.29	0-0.66	49.49	0.29	0-0.66	49.49	54			
1969	0.50	0.21-0.84	25.85	0.50	0.21-0.84	25.85	50			
1970	0.31	0-0.75	54.17	0.31	0-0.75	54.17	50			
1971	1.88	1.15-2.86	13.83	1.88	1.15-2.86	13.83	71			
1972	0.00	0.00	.	0.00	0.00	.	53			
1973	1.18	0.79-1.65	12.65	1.18	0.79-1.65	12.65	84			
1974	0.13	0.01-0.28	46.73	0.13	0.01-0.28	46.73	53			
1975	0.65	0.28-1.12	25.17	0.79	0.4-1.29	21.34	70			
1976	0.00	0.00	.	0.00	0.00	.	39			
1977	0.06	0-0.11	47.28	0.06	0-0.11	47.28	59			
1978	0.63	0.41-0.89	15.15	0.63	0.41-0.89	15.15	95			
1979	0.71	0.21-1.41	31.96	0.71	0.21-1.41	31.96	54			
1980	0.14	0.02-0.28	42.99	0.14	0.02-0.28	42.99	50			
1981	0.16	0.08-0.24	24.59	0.16	0.08-0.24	24.59	78			
1982	0.10	0.01-0.19	43.47	0.10	0.01-0.19	43.47	41			
1983	0.33	0.17-0.51	22.71	0.33	0.17-0.51	22.71	46		0.16	/ 49
1984	0.33	0.1-0.6	32.67	0.33	0.1-0.6	32.67	54		0.43	/ 54
1985	0.04	0-0.13	100.00	0.04	0-0.13	100.00	42		0.04	/ 42
1986	0.08	0.04-0.12	26.20	0.08	0.04-0.12	26.20	44		0.08	/ 44
1987	0.09	0-0.25	79.59	0.09	0-0.25	79.59	28		0.15	/ 27
1988	0.02	0-0.06	85.43	0.02	0-0.06	85.43	52		0.03	/ 52
1989	1.92	1.03-3.22	17.10	1.92	1.03-3.22	17.10	51		1.27	/ 52
1990	0.04	0-0.1	72.68	0.04	0-0.1	72.68	52		0.09	/ 52
1991	0.03	0-0.08	100.00	0.03	0-0.08	100.00	72		0.02	/ 52
1992	0.00	0.00	.	0.00	0.00	.	68		0.00	/ 52
1993	0.04	0-0.12	77.30	0.04	0-0.12	77.30	68		0.08	/ 52
1994	0.05	0-0.11	58.60	0.05	0-0.11	58.60	68		0.09	/ 52
1995	0.22	0.07-0.4	33.76	0.22	0.07-0.4	33.76	109		0.40	/ 52
1996	0.13	0.02-0.26	43.48	0.13	0.02-0.26	43.48	120		0.24	/ 53
1997	0.05	0-0.12	63.47	0.05	0-0.12	63.47	120		0.03	/ 52
1998	0.06	0-0.13	53.97	0.06	0-0.13	53.97	120		0.04	/ 51

Table 36. Converted (RSCI) and unconverted (RSI) indices for age 1+ channel catfish (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1954	0.00	0.00	.	0.00	0.00	.	2			
1955	0.00	0.00	.	0.00	0.00	.	5			
1956	0.00	0.00	.	0.00	0.00	.	13			
1957	0.11	0.01-0.22	45.47	0.11	0.01-0.22	45.47	20			
1958	0.00	0.00	.	0.00	0.00	.	5			
1959							0			
1960	0.00	0.00	.	0.00	0.00	.	6			
1961	0.86	0.16-1.97	37.79	0.86	0.16-1.97	37.79	12			
1962	0.26	0-0.66	61.69	0.26	0-0.66	61.69	14			
1963	0.07	0-0.18	67.11	0.07	0-0.18	67.11	24			
1964	0.67	0.34-1.08	21.40	0.67	0.34-1.08	21.40	33			
1965	0.29	0.15-0.45	22.93	0.29	0.15-0.45	22.93	42			
1966	0.60	0.13-1.26	36.87	0.60	0.13-1.26	36.87	43			
1967	0.40	0.08-0.81	38.24	0.40	0.08-0.81	38.24	34			
1968	0.27	0.05-0.54	39.70	0.27	0.05-0.54	39.70	54			
1969	0.50	0.26-0.79	21.78	0.50	0.26-0.79	21.78	50			
1970	1.27	0.76-1.92	15.57	1.27	0.76-1.92	15.57	50			
1971	0.48	0.19-0.85	27.91	0.48	0.19-0.85	27.91	71			
1972	0.00	0.00	.	0.00	0.00	.	53			
1973	1.54	1.09-2.1	10.56	1.54	1.09-2.1	10.56	84			
1974	0.33	0.14-0.55	26.87	0.33	0.14-0.55	26.87	53			
1975	1.03	0.56-1.64	18.45	0.98	0.53-1.57	18.87	70			
1976	0.00	0.00	.	0.00	0.00	.	39			
1977	0.38	0.18-0.62	24.65	0.38	0.18-0.62	24.65	59			
1978	0.94	0.65-1.28	12.05	0.94	0.65-1.28	12.05	95			
1979	1.96	0.82-3.81	22.42	1.96	0.82-3.82	22.39	54			
1980	1.89	1.33-2.59	10.21	1.89	1.33-2.59	10.21	50			
1981	0.54	0.26-0.88	23.22	0.54	0.26-0.88	23.22	78			
1982	0.40	0-1.08	59.47	0.40	0-1.08	59.47	41			
1983	1.97	1.36-2.75	10.70	1.97	1.36-2.75	10.70	46		0.91	/ 49
1984	2.37	1.32-3.88	15.30	2.37	1.32-3.88	15.30	54		1.69	/ 54
1985	2.92	1.82-4.45	12.03	2.92	1.82-4.45	12.03	42		1.81	/ 42
1986	1.53	1.29-1.79	5.30	1.53	1.29-1.79	5.30	44		0.84	/ 44
1987	0.94	0.36-1.77	26.61	0.94	0.36-1.77	26.61	28		0.85	/ 27
1988	1.41	1.05-1.82	9.09	1.41	1.05-1.82	9.09	52		0.91	/ 52
1989	1.10	0.52-1.91	21.82	1.10	0.52-1.91	21.82	51		1.20	/ 52
1990	2.67	1.79-3.83	10.56	2.67	1.79-3.83	10.56	52		1.52	/ 52
1991	3.37	2.27-4.82	9.78	3.37	2.27-4.82	9.78	72		1.73	/ 52
1992	1.87	1.3-2.58	10.47	1.87	1.3-2.58	10.47	68		1.48	/ 52
1993	0.83	0.2-1.8	35.01	0.83	0.2-1.8	35.01	68		1.15	/ 52
1994	0.81	0.48-1.22	17.04	0.81	0.48-1.22	17.04	68		1.49	/ 52
1995	0.69	0.39-1.05	18.45	0.69	0.39-1.05	18.45	109		0.58	/ 52
1996	1.08	0.6-1.71	17.84	1.08	0.6-1.71	17.84	120		1.17	/ 53
1997	0.84	0.47-1.3	18.21	0.84	0.47-1.3	18.21	120		1.06	/ 52
1998	0.85	0.49-1.29	17.61	0.85	0.49-1.29	17.61	120		0.71	/ 51

Table 37. Converted (RSCI) and unconverted (RSI) indices for northern puffer (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955	0.00	0.00	.	0.00	0.00	.	4			
1956	0.05	0-0.11	53.96	0.05	0-0.11	53.96	23			
1957	0.08	0-0.18	59.03	0.08	0-0.18	59.03	20			
1958	0.00	0.00	.	0.00	0.00	.	19			
1959	0.00	0.00	.	0.00	0.00	.	19			
1960	0.02	0-0.07	100.00	0.02	0-0.07	100.00	10			
1961	0.22	0-0.8	100.00	0.22	0-0.8	100.00	7			
1962	0.18	0-0.63	100.00	0.18	0-0.63	100.00	4			
1963	0.21	0-0.53	61.24	0.21	0-0.53	61.24	8			
1964	0.44	0-1.44	72.14	0.44	0-1.44	72.14	8			
1965							0			
1966	0.23	0-0.71	82.25	0.23	0-0.71	82.25	8			
1967	0.18	0-0.44	58.66	0.18	0-0.44	58.66	8			
1968	1.35	0.75-2.14	17.08	1.35	0.75-2.14	17.08	8			
1969	0.42	0-1.04	51.09	0.42	0-1.04	51.09	8			
1970	0.16	0-0.41	69.83	0.16	0-0.41	69.83	8			
1971	0.57	0.12-1.19	37.57	0.57	0.12-1.19	37.57	8			
1972	0.28	0.00	.	0.28	0.00	.	2			
1973							0			
1974	0.00	0.00	.	0.00	0.00	.	76			
1975	0.02	0-0.06	71.82	0.02	0-0.06	71.82	74			
1976	0.00	0.00	.	0.00	0.00	.	90			
1977	0.00	0.00	.	0.00	0.00	.	68			
1978	0.00	0.00	100.00	0.00	0.00	100.00	95			
1979	0.00	0.00	.	0.00	0.00	.	4			
1980	0.36	0-1.02	65.81	0.36	0-1.02	65.81	15			
1981	0.00	0.00	.	0.00	0.00	.	9			
1982	0.00	0.00	.	0.00	0.00	.	5			
1983							0			
1984							0			
1985							0			
1986							0			
1987							0			
1988	0.84	0.58-1.15	12.43	0.84	0.58-1.15	12.43	147	0.84		147 /
1989	0.79	0.61-0.99	9.00	0.79	0.61-0.99	9.00	168	0.79		168 /
1990	0.68	0.49-0.9	11.83	0.68	0.49-0.9	11.83	167	0.68		167 /
1991	0.45	0.32-0.59	12.78	0.45	0.32-0.59	12.78	155	0.45		155 /
1992	0.11	0.06-0.17	22.68	0.11	0.06-0.17	22.68	156	0.11		156 /
1993	0.17	0.1-0.24	18.28	0.17	0.1-0.24	18.28	156	0.17		156 /
1994	0.10	0.05-0.16	26.01	0.10	0.05-0.16	26.01	156	0.10		156 /
1995	0.08	0.04-0.12	24.11	0.08	0.04-0.12	24.11	156	0.08		156 /
1996	0.14	0.08-0.22	22.94	0.14	0.08-0.22	22.94	156	0.14		156 /
1997	0.20	0.12-0.28	18.18	0.20	0.12-0.28	18.18	156	0.20		156 /
1998	0.09	0.04-0.14	27.44	0.09	0.04-0.14	27.44	118	0.09		118 /

Table 38. Converted (RSCI) and unconverted (RSI) indices for silver perch (1955-98), with reference to originally reported bay and river index (BRI) values (1979-98).

	Converted Index			Unconverted Index				Original Index		
Year	Geo. Mean	95% C.I.'s	C.V.	Geo. Mean	95% C.I.s	C.V.	N	Bay & River	River Only	N's
1955	13.34	0.00	.	33.71	0.00	.	3			
1956	7.30	2.69-17.67	19.14	18.43	7.62-42.81	13.70	43			
1957	15.59	6.92-33.74	13.16	30.16	15.46-57.99	9.28	43			
1958	2.75	0.54-8.11	33.61	6.60	2-18.22	22.88	42			
1959	5.02	0.42-24.49	40.20	11.74	1.98-53.44	28.53	42			
1960							0			
1961	3.70	0.84-11.01	30.29	12.22	4.48-30.9	17.06	20			
1962	1.29	0.77-1.98	15.67	1.82	1.27-2.5	10.51	13			
1963	29.70	11.61-73.79	13.00	51.20	18.17-141.17	12.67	24			
1964	1.04	0-3.4	54.15	2.02	0.59-4.72	28.91	34			
1965	0.49	0.28-0.73	18.81	1.35	0.87-1.94	13.19	38			
1966	0.47	0-1.28	57.83	1.04	0-3.69	58.13	42			
1967	0.40	0.11-0.75	33.92	0.55	0.2-1.01	29.62	66			
1968	1.45	0-7.86	71.84	2.07	0-13.14	67.96	66			
1969	3.10	0-16.68	51.88	3.80	0-25.02	53.89	69			
1970	11.12	2.62-39.64	24.24	23.53	8.08-65.26	15.53	68			
1971	4.16	3.54-4.86	3.88	8.61	7.26-10.19	3.36	183			
1972	0.69	0.51-0.91	11.14	0.69	0.51-0.91	11.14	161			
1973	0.34	0.23-0.47	15.30	0.34	0.23-0.47	15.30	209			
1974	0.06	0.01-0.11	41.36	0.06	0.01-0.11	41.36	73			
1975	0.05	0-0.11	52.59	0.05	0-0.11	52.59	54			
1976	0.26	0.07-0.48	34.39	0.19	0.06-0.33	32.01	108			
1977	0.03	0-0.06	48.53	0.03	0-0.06	48.53	78			
1978	0.07	0-0.19	76.37	0.07	0-0.19	76.37	78			
1979	0.05	0.02-0.08	27.64	0.05	0.02-0.08	27.64	97		0.17	/ 95
1980	0.06	0-0.17	72.55	0.12	0-0.26	56.21	121		0.07	/ 112
1981	0.00	0.00	66.82	0.15	0-0.48	88.03	118		0.06	/ 112
1982	0.02	0-0.03	40.87	0.05	0.02-0.09	29.57	118		0.16	/ 114
1983	0.00	0.00	.	0.06	0.01-0.1	37.52	113		0.06	/ 113
1984	0.00	0.00	.	0.02	0-0.05	73.77	95		0.02	/ 99
1985	0.16	0.06-0.27	31.13	0.34	0.17-0.54	23.50	58		0.68	/ 59
1986	0.10	0.03-0.17	33.23	0.26	0.13-0.4	23.44	107		0.34	/ 107
1987	0.24	0.11-0.37	24.38	0.42	0.25-0.62	18.37	100		0.53	/ 100
1988	0.39	0.22-0.59	20.46	0.61	0.35-0.92	18.30	172	0.65	1.02	172 / 65
1989	0.28	0.16-0.41	19.62	0.53	0.33-0.76	16.32	189	0.56	1.63	189 / 63
1990	0.40	0.28-0.54	13.36	0.69	0.49-0.92	11.94	185	0.75	4.08	185 / 59
1991	0.36	0.22-0.51	17.33	0.36	0.22-0.51	17.33	251	0.40	1.47	179 / 62
1992	0.80	0.49-1.16	15.80	0.80	0.49-1.16	15.80	226	0.86	1.95	178 / 61
1993	0.43	0.28-0.61	16.01	0.43	0.28-0.61	16.01	224	0.45	0.60	180 / 63
1994	0.25	0.12-0.4	25.42	0.25	0.12-0.4	25.42	225	0.26	0.37	180 / 63
1995	0.62	0.39-0.89	15.65	0.62	0.39-0.89	15.65	291	0.65	1.81	180 / 67
1996	0.59	0.38-0.84	15.63	0.59	0.38-0.84	15.63	304	0.58	1.18	183 / 66
1997	0.71	0.5-0.94	12.07	0.71	0.5-0.94	12.07	316	0.79	1.43	192 / 75
1998	0.24	0.15-0.33	16.77	0.24	0.15-0.33	16.77	316	0.24	0.53	192 / 75

Table 39. Comparison of geometric means for fixed stations (simple) and random stations (weighted) utilizing t-test and Pearson correlation statistics. The values under each system represents the number of months of sampling used in analysis. The variance of the two means are shown as equal (Eq) or unequal (Un) at $p < 0.1$. The means indicate significant differences, and Pearson correlation coefficients are shown with $p < 0.1$ (*), $p < 0.01$ (**), and $p < 0.001$ (***).

Species	Statistical Variable	James (40,40)	Rappahannock (46,46)	York (98,98)
Spot	Variance	Un	Eq	Eq
	Pearson R	0.5985***	0.7117***	0.6130***
	Mean F,R	(6.53,10.15)	(9.33,6.63)	(3.30,8.05)**
Atlantic Croaker	Variance	Eq	Un	Eq
	Pearson R	0.6022***	0.2676*	0.5063***
	Mean F,R	(11.88,15.75)	(22.55,14.65)	(39.40,22.16)***
Weakfish	Variance	Un	Eq	Eq
	Pearson R	0.9218***	0.7623***	0.7094***
	Mean F,R	(3.05,2.99)	(7.15,3.53)	(12.83,5.78)*
Summer flounder	Variance	Un	Eq	Eq
	Pearson R	0.4713 **	0.3349 *	0.6351 ***
	Mean F,R	(0.43, 0.28)*	(0.13,0.38)***	(0.40,0.87)***
Black seabass	Variance	Un	Eq	Eq
	Pearson R	0.2489	-0.0491	0.2880**
	Mean F,R	(0.13, 0.09)	(0.00, 0.01)	(0.00, 0.05)***
Scup		Too few captured on rivers for analysis.		
Striped bass	Variance	Eq	Eq	Eq
	Pearson R	0.7254***	0.1201	0.5951***
	Mean F,R	(0.55,0.74)	(0.74,0.31)	(0.57,0.26)***
White perch	Variance	Eq	Eq	Eq
	Pearson R	0.4486**	0.0561	0.7662***
	Mean F,R	(7.31,5.93)	(10.72,2.62)*	(3.24,0.77)***
White catfish	Variance	Eq	Eq	Eq
	Pearson R	0.3448*	0.2330	0.7567***
	Mean F,R	(0.72,0.46)*	(1.11,0.29)***	(1.47,0.20)***
Channel catfish	Variance	Eq	Eq	Eq
	Pearson R	0.4356**	0.1743	0.2937**
	Mean F,R	(0.35,0.35)	(0.31,0.16)**	(0.08,0.00)***
Northern Puffer		Too few captured on rivers for analysis.		
Silver Perch	Variance	Eq	Eq	Eq
	Pearson R	0.4153**	0.8072***	0.8194***
	Mean F,R	(0.20,0.31)	(0.62,0.16)	1.48,0.71)*

Table 40. Species composition statistics for Mobjack Bay, July 1998.

Month - July, 1998
System - Mobjack Bay & Tribs.
No. of Random Trawls Made - 10
No. of Fixed Trawls Made - 7
No. of Species - 28
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	2,308	16	46.49	135.76	.	87	63	0.49	30	87
spot	1,183	16	23.83	69.59	45.73	1,146	104	0.68	47	221
jellyfish spp	505	14	10.17	29.71	19.52	.	.	.	.	
Atlantic croaker	297	16	5.98	17.47	11.48	254	157	2.61	98	350
blue crab, juvenile female	251	17	5.06	14.76	9.70	.	67	1.04	29	114
blue crab, male	165	17	3.32	9.71	6.38	.	75	2.28	22	154
hogchoker	70	10	1.41	4.12	.	5	99	1.56	73	128
weakfish	56	11	1.13	3.29	2.16	40	117	10.86	30	286
summer flounder	49	16	0.99	2.88	1.89	35	194	11.06	71	418
inshore lizardfish	25	13	0.50	1.47	0.97	25	109	3.75	86	145
silver perch	11	3	0.22	0.65	0.43	1	173	12.35	62	210
blackcheek tonguefish	10	6	0.20	0.59	0.39	10	107	2.53	95	116
northern pipefish	9	4	0.18	0.53	0.35	.	149	9.28	117	206
blue crab, adult female	5	3	0.10	0.29	0.19	.	140	4.17	130	152
Atlantic cutlassfish	4	4	0.08	0.24	0.15	.	281	25.12	228	340
butterfish	3	3	0.06	0.18	0.12	3	52	4.98	43	60
oyster toadfish	3	2	0.06	0.18	0.12	.	117	10.73	96	130
black seabass	1	1	0.02	0.06	0.04	1	130	.	130	130
striped bass	1	1	0.02	0.06	0.04	0	316	.	316	316
spotted seatrout	1	1	0.02	0.06	0.04	.	29	.	29	29
striped searobin	1	1	0.02	0.06	0.04	.	216	.	216	216
lined seahorse	1	1	0.02	0.06	0.04	.	124	.	124	124
green goby	1	1	0.02	0.06	0.04	.	47	.	47	47
naked goby	1	1	0.02	0.06	0.04	.	45	.	45	45
feather blenny	1	1	0.02	0.06	0.04	.	96	.	96	96
conger eel	1	1	0.02	0.06	0.04	.	465	.	465	465
spider crab, common	1	1	0.02	0.06	0.04	.	.	.	.	
brown shrimp	1	1	0.02	0.06	0.04	.	134	.	134	134
mud crab spp	.	3	.	.	.	.	.	.	.	
grass shrimp spp	.	2	.	.	.	.	.	.	.	
periwinkle spp	.	1	.	.	.	.	.	.	.	
quahog clam	.	1	.	.	.	.	.	.	.	
ribbed mussel	.	1	.	.	.	.	.	.	.	
All Species Combined	4,965									

Table 41. Species composition statistics for Mobjack Bay, November 1998.

Month - November, 1998
System - Mobjack Bay & Tribs.
No. of Random Trawls Made - 11
No. of Fixed Trawls Made - 7
No. of Species - 29
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Leng (m
bay anchovy	11,471	18	66.53	637.28	.	10,672	52	0.52	29	79
Atlantic croaker	4,674	18	27.11	259.67	81.27	4,458	66	2.01	20	237
spot	425	16	2.47	23.61	7.39	425	137	0.71	105	187
blue crab, juvenile female	162	18	0.94	9.00	2.82	.	47	1.35	22	119
blue crab, male	133	18	0.77	7.39	2.31	.	57	2.56	21	133
weakfish	125	13	0.73	6.94	2.17	125	145	2.22	80	200
silver perch	69	7	0.40	3.83	1.20	67	124	1.92	93	197
blackcheek tonguefish	24	13	0.14	1.33	0.42	12	106	8.34	51	165
seaboard goby	24	5	0.14	1.33	0.42	.	38	1.52	31	45
summer flounder	23	13	0.13	1.28	0.40	17	289	8.68	243	384
blue crab, adult female	22	8	0.13	1.22	0.38	.	131	2.99	111	154
hogchoker	19	10	0.11	1.06	.	0	109	3.30	91	141
kingfish spp	15	8	0.09	0.83	0.26	14	125	10.44	68	201
butterfish	14	7	0.08	0.78	0.24	9	147	5.24	122	189
naked goby	13	6	0.08	0.72	0.23	.	39	1.94	27	47
squid spp	5	2	0.03	0.28	0.09	.	76	6.38	55	95
bluefish	4	4	0.02	0.22	0.07	.	149	5.96	136	161
northern pipefish	4	3	0.02	0.22	0.07	.	133	14.35	95	162
spider crab, 6 spine	4	2	0.02	0.22	0.07	.	.	.	.	.
oyster toadfish	2	1	0.01	0.11	0.03	.	120	47.00	73	167
black seabass	1	1	0.01	0.06	0.02	0	194	.	194	194
red hake	1	1	0.01	0.06	0.02	.	57	.	57	57
northern searobin	1	1	0.01	0.06	0.02	1	85	.	85	85
lined seahorse	1	1	0.01	0.06	0.02	.	49	.	49	49
feather blenny	1	1	0.01	0.06	0.02	.	55	.	55	55
Atlantic moonfish	1	1	0.01	0.06	0.02	.	69	.	69	69
mantis shrimp	1	1	0.01	0.06	0.02	.	69	.	69	69
brown shrimp	1	1	0.01	0.06	0.02	.	119	.	119	119
channel (smooth) whelk	1	1	0.01	0.06	0.02	.	.	.	.	
sand shrimp	.	11	.	.	.	.	.	.	.	
grass shrimp spp	.	7	.	.	.	.	.	.	.	
mud crab spp	.	6	.	.	.	.	.	.	.	
soft-shell clam	.	4	.	.	.	.	.	.	.	
right-hand hermit crab spp	.	3	.	.	.	.	.	.	.	
moon snail	.	1	.	.	.	.	.	.	.	
All Species Combined	17,241									

Table 42. Species composition statistics for Mobjack Bay, February 1999.

Month - February, 1999
System - Mobjack Bay & Tribs.
No. of Random Trawls Made - 10
No. of Fixed Trawls Made - 7
No. of Species - 9
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	8	2	33.33	0.47	.	8	47	2.37	37	59
naked goby	5	2	20.83	0.29	31.25	.	39	1.30	35	43
Atlantic silverside	2	2	8.33	0.12	12.50	2	82	1.00	81	83
blue crab, male	2	2	8.33	0.12	12.50	.	25	8.00	17	33
Atlantic menhaden	2	1	8.33	0.12	12.50	2	35	0.00	35	35
feather blenny	2	1	8.33	0.12	12.50	.	44	1.00	43	45
blueback herring	1	1	4.17	0.06	6.25	1	81	.	81	81
green goby	1	1	4.17	0.06	6.25	.	49	.	49	49
skilletfish	1	1	4.17	0.06	6.25	.	31	.	31	31
sand shrimp	.	8	.	.	.	.	.	.	.	
grass shrimp spp	.	5	.	.	.	.	.	.	.	
mud crab spp	.	3	.	.	.	.	.	.	.	
mysid shrimp	.	3	.	.	.	.	.	.	.	
little surf clam	.	2	.	.	.	.	.	.	.	
right-hand hermit crab spp	.	1	.	.	.	.	.	.	.	
leech spp	.	1	.	.	.	.	.	.	.	
All Species Combined	24									

Table 43. Species composition statistics for Mobjack Bay, April 1999.

Month - April, 1999
System - Mobjack Bay & Tribs.
No. of Random Trawls Made - 10
No. of Fixed Trawls Made - 7
No. of Species - 25
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	519	13	43.39	30.53	.	515	55	0.71	32	83
Atlantic herring	427	12	35.70	25.12	63.17	.	45	0.31	29	63
blue crab, male	84	13	7.02	4.94	12.43	.	72	3.69	11	131
blue crab, juvenile female	50	13	4.18	2.94	7.40	.	44	3.41	17	109
Atlantic croaker	46	9	3.85	2.71	6.80	3	248	11.41	24	374
sand shrimp	10	15	0.84	0.59	1.48	.	.	.	.	
summer flounder	9	5	0.75	0.53	1.33	0	347	25.62	259	477
striped bass	8	3	0.67	0.47	1.18	8	117	5.37	94	138
blue crab, adult female	7	4	0.59	0.41	1.04	.	130	3.41	114	143
alewife	7	1	0.59	0.41	1.04	7	120	2.68	108	129
naked goby	6	2	0.50	0.35	0.89	.	40	3.45	30	52
Atlantic menhaden	5	1	0.42	0.29	0.74	5	30	1.61	25	35
spotted hake	3	3	0.25	0.18	0.44	3	84	29.20	52	142
spider crab, common	3	2	0.25	0.18	0.44	.	.	.	.	
northern searobin	2	1	0.17	0.12	0.30	2	63	4.00	59	67
spot	1	1	0.08	0.06	0.15	0	243	.	243	243
American eel	1	1	0.08	0.06	0.15	.	480	.	480	480
northern pipefish	1	1	0.08	0.06	0.15	.	97	.	97	97
striped blenny	1	1	0.08	0.06	0.15	.	78	.	78	78
feather blenny	1	1	0.08	0.06	0.15	.	38	.	38	38
hogchoker	1	1	0.08	0.06	.	0	115	.	115	115
skilletfish	1	1	0.08	0.06	0.15	.	54	.	54	54
oyster toadfish	1	1	0.08	0.06	0.15	.	160	.	160	160
spider crab, 6 spine	1	1	0.08	0.06	0.15	.	.	.	.	
channel (smooth) whelk	1	1	0.08	0.06	0.15	.	.	.	.	
Amphipod spp	.	15	.	.	.	.	.	.	.	
grass shrimp spp	.	11	.	.	.	.	.	.	.	
mysid shrimp	.	9	.	.	.	.	.	.	.	
mud crab spp	.	8	.	.	.	.	.	.	.	
little surf clam	.	7	.	.	.	.	.	.	.	
jellyfish spp	.	6	.	.	.	.	.	.	.	
worm spp	.	5	.	.	.	.	.	.	.	
drill & snail spp	.	5	.	.	.	.	.	.	.	
soft-shell clam	.	2	.	.	.	.	.	.	.	
big-clawed snapping shrimp	.	1	.	.	.	.	.	.	.	
skeleton shrimp spp	.	1	.	.	.	.	.	.	.	
right-hand hermit crab spp	.	1	.	.	.	.	.	.	.	
blue mussel	.	1	.	.	.	.	.	.	.	
All Species Combined	1,196									

Table 44. Species composition statistics for Piankatank River, September 1998.

Month - September, 1998
System - Piankatank River
No. of Random Trawls Made - 4
No. of Fixed Trawls Made - 3
No. of Species - 23
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	23,630	6	96.60	3375.71	.	23,600	39	0.32	25	61
spot	318	6	1.30	45.43	41.03	303	137	1.58	99	235
weakfish	137	5	0.56	19.57	17.68	123	93	5.04	33	275
Atlantic croaker	122	7	0.50	17.43	15.74	73	79	5.99	13	205
hogchoker	57	3	0.23	8.14	.	0	86	2.07	57	123
harvestfish	45	5	0.18	6.43	5.81	45	81	2.89	32	115
kingfish spp	33	3	0.13	4.71	4.26	33	67	1.88	49	89
summer flounder	32	6	0.13	4.57	4.13	15	275	11.37	178	438
blue crab, male	23	5	0.09	3.29	2.97	.	78	7.11	23	143
striped anchovy	19	6	0.08	2.71	2.45	19	73	2.14	63	100
blue crab, juvenile female	14	5	0.06	2.00	1.81	.	57	9.97	15	126
blue crab, adult female	7	3	0.03	1.00	0.90	.	136	3.56	116	145
silver perch	4	4	0.02	0.57	0.52	3	119	32.78	51	204
inshore lizardfish	4	3	0.02	0.57	0.52	3	168	18.30	125	214
Atlantic thread herring	3	2	0.01	0.43	0.39	.	76	28.01	47	132
striped searobin	3	2	0.01	0.43	0.39	.	90	8.74	73	101
white perch	3	1	0.01	0.43	0.39	0	213	2.19	210	217
blackcheek tonguefish	3	1	0.01	0.43	0.39	0	133	5.29	123	141
striped bass	1	1	0.00	0.14	0.13	0	222	.	222	222
spotted seatrout	1	1	0.00	0.14	0.13	.	53	.	53	53
seaboard goby	1	1	0.00	0.14	0.13	.	46	.	46	46
smallmouth flounder	1	1	0.00	0.14	0.13	1	66	.	66	66
spider crab, common	1	1	0.00	0.14	0.13	.	.	.	.	
worm spp	.	1	.	.	.	.	.	.	.	
soft-shell clam	.	1	.	.	.	.	.	.	.	
All Species Combined	24,462									

Table 45. Species composition statistics for Piankatank River, October 1998.

Month - October, 1998
System - Piankatank River
No. of Random Trawls Made - 4
No. of Fixed Trawls Made - 3
No. of Species - 20
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	2,540	6	47.56	362.86	.	1,892	55	0.95	29	79
Atlantic croaker	1,778	7	33.29	254.00	65.56	1,092	90	4.74	15	256
spot	534	6	10.00	76.29	19.69	527	141	0.94	111	237
weakfish	230	6	4.31	32.86	8.48	222	124	3.24	70	314
hogchoker	89	5	1.67	12.71	.	0	98	2.60	81	137
blue crab, male	34	5	0.64	4.86	1.25	.	59	6.57	18	160
blue crab, juvenile female	30	7	0.56	4.29	1.11	.	56	5.61	25	126
silver perch	24	3	0.45	3.43	0.88	24	112	1.09	101	122
striped anchovy	21	4	0.39	3.00	0.77	21	92	2.77	66	109
summer flounder	18	7	0.34	2.57	0.66	16	248	5.99	220	333
harvestfish	13	5	0.24	1.86	0.48	13	91	2.72	72	104
kingfish spp	8	2	0.15	1.14	0.29	8	88	7.88	49	125
inshore lizardfish	7	4	0.13	1.00	0.26	2	205	12.10	149	233
blue crab, adult female	5	3	0.09	0.71	0.18	.	137	4.46	123	150
Atlantic spadefish	4	4	0.07	0.57	0.15	.	73	6.54	60	85
striped searobin	2	1	0.04	0.29	0.07	.	155	7.50	147	162
white perch	1	1	0.02	0.14	0.04	0	195	.	195	195
black drum	1	1	0.02	0.14	0.04	.	204	.	204	204
bluespotted cornetfish	1	1	0.02	0.14	0.04	.	541	.	541	541
blackcheek tonguefish	1	1	0.02	0.14	0.04	0	162	.	162	162
macoma clam spp	.	3	.	.	.	.	.	.	.	
sand shrimp	.	2	.	.	.	.	.	.	.	
grass shrimp spp	.	2	.	.	.	.	.	.	.	
soft-shell clam	.	1	.	.	.	.	.	.	.	
quahog clam	.	1	.	.	.	.	.	.	.	
All Species Combined	5,341									

Table 46. Species composition statistics for Piankatank River, January 1999.

Month - January, 1999
System - Piankatank River
No. of Random Trawls Made - 4
No. of Fixed Trawls Made - 3
No. of Species - 9
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	22	3	55.00	3.14	.	22	40	0.99	34	54
skilletfish	5	2	12.50	0.71	35.71	.	53	3.44	46	62
hogchoker	4	1	10.00	0.57	.	4	34	2.71	26	38
Atlantic croaker	2	2	5.00	0.29	14.29	2	62	14.00	48	76
Atlantic silverside	2	2	5.00	0.29	14.29	2	90	13.00	77	103
blue crab, male	2	2	5.00	0.29	14.29	.	96	39.50	56	135
naked goby	1	1	2.50	0.14	7.14	.	45	.	45	45
slipper shell spp	1	1	2.50	0.14	7.14	.	.	.	.	.
blue crab, juvenile female	1	1	2.50	0.14	7.14	.	42	.	42	42
little surf clam	.	7	.	.	.	.	.	.	.	
sand shrimp	.	2	.	.	.	.	.	.	.	
mud crab spp	.	1	.	.	.	.	.	.	.	
macoma clam spp	.	1	.	.	.	.	.	.	.	
quahog clam	.	1	.	.	.	.	.	.	.	
All Species Combined	40									

Table 47. Species composition statistics for Piankatank River, June 1999.

Month - June, 1999
System - Piankatank River
No. of Random Trawls Made - 3
No. of Fixed Trawls Made - 3
No. of Species - 18
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	5,323	7	91.23	887.17	.	5,272	54	0.49	44	83
spot	289	6	4.95	48.17	60.21	245	101	2.00	37	203
Atlantic croaker	49	6	0.84	8.17	10.21	0	245	5.70	199	372
weakfish	40	6	0.69	6.67	8.33	4	189	1.85	160	222
blue crab, juvenile female	35	6	0.60	5.83	7.29	.	74	3.31	34	108
hogchoker	32	4	0.55	5.33	.	5	87	3.65	49	130
blue crab, male	25	3	0.43	4.17	5.21	.	83	4.41	41	135
Atlantic menhaden	14	2	0.24	2.33	2.92	14	41	0.91	36	46
blue crab, adult female	13	2	0.22	2.17	2.71	.	141	3.22	125	169
summer flounder	4	3	0.07	0.67	0.83	1	310	72.03	117	439
mud crab spp	3	4	0.05	0.50	0.63	.	.	.	.	.
American eel	2	2	0.03	0.33	0.42	.	270	0.50	269	270
alewife	1	1	0.02	0.17	0.21	1	45	.	45	45
striped bass	1	1	0.02	0.17	0.21	0	196	.	196	196
striped anchovy	1	1	0.02	0.17	0.21	1	97	.	97	97
naked goby	1	1	0.02	0.17	0.21	.	37	.	37	37
mysid shrimp	1	1	0.02	0.17	0.21	.	.	.	.	
Amphipod spp	1	1	0.02	0.17	0.21	.	.	.	.	
jellyfish spp	.	6	.	.	.	.	.	.	.	
All Species Combined	5,835									

Table 48. Species composition statistics for Great Wicomico River, September 1998.

Month - September, 1998
System - Great Wicomico River
No. of Random Trawls Made - 6
No. of Fixed Trawls Made - 0
No. of Species - 22
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	4,293	6	74.61	715.50	.	4,218	36	0.48	24	64
striped anchovy	499	4	8.67	83.17	34.34	499	55	1.81	43	85
spot	417	6	7.25	69.50	28.70	416	136	0.79	106	226
Atlantic croaker	277	5	4.81	46.17	19.06	203	68	5.92	21	207
weakfish	94	5	1.63	15.67	6.47	92	59	4.57	31	206
blue crab, male	63	6	1.09	10.50	4.34	.	68	4.99	18	141
blue crab, juvenile female	40	6	0.70	6.67	2.75	.	53	3.84	17	93
blue crab, adult female	12	4	0.21	2.00	0.83	.	140	2.67	128	156
blue crab, sex unknown	12	1	0.21	2.00	0.83	.	18	1.71	2	26
inshore lizardfish	9	4	0.16	1.50	0.62	3	204	7.58	156	230
summer flounder	8	4	0.14	1.33	0.55	7	253	36.59	194	500
hogchoker	8	2	0.14	1.33	.	0	108	3.19	98	122
Atlantic thread herring	5	1	0.09	0.83	0.34	.	69	1.54	64	72
naked goby	4	3	0.07	0.67	0.28	.	41	2.93	34	48
harvestfish	3	2	0.05	0.50	0.21	3	73	0.58	72	74
blackcheek tonguefish	3	2	0.05	0.50	0.21	1	93	26.54	40	122
kingfish spp	2	1	0.03	0.33	0.14	2	82	7.50	74	89
Atlantic spadefish	1	1	0.02	0.17	0.07	.	76	.	76	76
northern pipefish	1	1	0.02	0.17	0.07	.	73	.	73	73
striped blenny	1	1	0.02	0.17	0.07	.	60	.	60	60
oyster toadfish	1	1	0.02	0.17	0.07	.	142	.	142	142
mantis shrimp	1	1	0.02	0.17	0.07	.	41	.	41	41
mud crab spp	.	4	.	.	.	.	.	.	.	
sand shrimp	.	4	.	.	.	.	.	.	.	
worm spp	.	3	.	.	.	.	.	.	.	
grass shrimp spp	.	2	.	.	.	.	.	.	.	
Amphipod spp	.	1	.	.	.	.	.	.	.	
All Species Combined	5,754									

Table 49. Species composition statistics for Great Wicomico River, October 1998.

Month - October, 1998
System - Great Wicomico River
No. of Random Trawls Made - 6
No. of Fixed Trawls Made - 0
No. of Species - 21
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	3,706	6	63.30	617.67	.	3,313	40	1.12	20	76
Atlantic croaker	1,296	6	22.13	216.00	62.01	1,119	61	3.38	21	217
spot	365	5	6.23	60.83	17.46	365	142	0.78	111	187
weakfish	154	4	2.63	25.67	7.37	148	100	5.95	51	303
blue crab, male	112	5	1.91	18.67	5.36	.	51	3.13	12	129
blue crab, juvenile female	106	5	1.81	17.67	5.07	.	38	2.36	16	116
hogchoker	59	3	1.01	9.83	.	0	93	1.86	65	135
blue crab, adult female	14	4	0.24	2.33	0.67	.	138	2.88	120	159
summer flounder	9	4	0.15	1.50	0.43	7	247	11.60	205	315
naked goby	6	2	0.10	1.00	0.29	.	38	2.49	28	44
silver perch	6	2	0.10	1.00	0.29	6	100	6.75	89	129
inshore lizardfish	5	4	0.09	0.83	0.24	1	227	9.53	199	248
striped blenny	5	2	0.09	0.83	0.24	.	63	7.43	46	86
striped anchovy	3	2	0.05	0.50	0.14	3	93	6.64	82	105
white shrimp	2	2	0.03	0.33	0.10	.	101	21.00	80	122
oyster toadfish	2	1	0.03	0.33	0.10	.	193	22.50	170	215
red drum	1	1	0.02	0.17	0.05	.	395	.	395	395
American eel	1	1	0.02	0.17	0.05	.	439	.	439	439
Atlantic spadefish	1	1	0.02	0.17	0.05	.	69	.	69	69
northern pipefish	1	1	0.02	0.17	0.05	.	84	.	84	84
blackcheek tonguefish	1	1	0.02	0.17	0.05	1	53	.	53	53
grass shrimp spp	.	3	.	.	.	.	.	.	.	
mud crab spp	.	2	.	.	.	.	.	.	.	
sand shrimp	.	2	.	.	.	.	.	.	.	
oyster, common	.	2	.	.	.	.	.	.	.	
worm spp	.	1	.	.	.	.	.	.	.	
All Species Combined	5,855									

Table 50. Species composition statistics for Great Wicomico River, January 1999.

Month - January, 1999
System - Great Wicomico River
No. of Random Trawls Made - 6
No. of Fixed Trawls Made - 0
No. of Species - 6
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
skilletfish	2	2	28.57	0.33	33.33	.	30	3.00	27	33
Atlantic croaker	1	1	14.29	0.17	16.67	1	22	.	22	22
bay anchovy	1	1	14.29	0.17	.	1	40	.	40	40
feather blenny	1	1	14.29	0.17	16.67	.	46	.	46	46
blue crab, male	1	1	14.29	0.17	16.67	.	20	.	20	20
blue crab, juvenile female	1	1	14.29	0.17	16.67	.	26	.	26	26
little surf clam	.	6	.	.	.	.	.	.	.	
grass shrimp spp	.	3	.	.	.	.	.	.	.	
mud crab spp	.	1	.	.	.	.	.	.	.	
soft-shell clam	.	1	.	.	.	.	.	.	.	
oyster, common	.	1	.	.	.	.	.	.	.	
Amphipod spp	.	1	.	.	.	.	.	.	.	
All Species Combined	7									

Table 51. Species composition statistics for Great Wicomico River, June 1999.

Month - June, 1999
System - Great Wicomico River
No. of Random Trawls Made - 6
No. of Fixed Trawls Made - 0
No. of Species - 15
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	4,746	6	94.58	791.00	.	4,673	54	0.49	40	82
spot	139	5	2.77	23.17	51.29	134	98	2.05	66	196
oyster, common	30	3	0.60	5.00	11.07	.	.	.	.	
blue crab, male	27	5	0.54	4.50	9.96	.	76	6.44	17	145
blue crab, juvenile female	26	5	0.52	4.33	9.59	.	58	4.54	17	122
Atlantic croaker	15	5	0.30	2.50	5.54	1	233	15.65	94	376
mud crab spp	7	2	0.14	1.17	2.58	.	.	.	.	
grass shrimp spp	5	2	0.10	0.83	1.85	.	.	.	.	
bent mussel	5	1	0.10	0.83	1.85	.	.	.	.	
summer flounder	4	2	0.08	0.67	1.48	4	125	7.19	111	141
northern searobin	4	2	0.08	0.67	1.48	4	97	3.18	91	102
drill & snail spp	4	1	0.08	0.67	1.48	.	.	.	.	
blue crab, adult female	3	1	0.06	0.50	1.11	.	134	10.02	115	149
winter flounder	2	1	0.04	0.33	0.74	.	67	5.00	62	72
hogchoker	1	1	0.02	0.17	.	0	97	.	97	97
jellyfish spp	.	6	.	.	.	.	.	.	.	
All Species Combined	5,018									

Table 52. Species composition statistics for Pocomoke Sound, September 1998.

Month - September, 1998
System - Pocomoke Sound
No. of Random Trawls Made - 11
No. of Fixed Trawls Made - 3
No. of Species - 29
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	7,301	13	61.02	521.50	.	4,197	56	0.79	27	86
Atlantic croaker	2,589	14	21.64	184.93	59.76	1,770	86	3.67	18	342
kingfish spp	568	14	4.75	40.57	13.11	540	84	1.20	41	181
weakfish	377	12	3.15	26.93	8.70	338	108	2.65	48	318
hogchoker	332	13	2.77	23.71	.	0	122	1.68	83	178
spot	222	10	1.86	15.86	5.12	209	153	1.35	121	237
blackcheek tonguefish	189	11	1.58	13.50	4.36	2	145	1.31	41	171
blue crab, juvenile female	147	10	1.23	10.50	3.39	.	38	1.74	11	111
blue crab, male	77	11	0.64	5.50	1.78	.	40	2.97	9	131
silver perch	30	6	0.25	2.14	0.69	24	133	6.17	99	217
mantis shrimp	21	7	0.18	1.50	0.48	.	74	3.23	44	102
jellyfish spp	17	1	0.14	1.21	0.39	.	.	.	.	
spider crab, common	15	5	0.13	1.07	0.35	.	.	.	.	
blue crab, adult female	14	5	0.12	1.00	0.32	.	134	2.05	125	149
summer flounder	13	5	0.11	0.93	0.30	1	335	12.63	247	423
oyster toadfish	13	3	0.11	0.93	0.30	.	231	17.02	152	312
harvestfish	7	2	0.06	0.50	0.16	7	90	2.62	83	104
northern pipefish	7	2	0.06	0.50	0.16	.	121	19.70	83	234
spider crab, 6 spine	5	2	0.04	0.36	0.12	.	.	.	.	
Atlantic spadefish	4	3	0.03	0.29	0.09	.	57	1.71	52	60
inshore lizardfish	4	3	0.03	0.29	0.09	1	233	17.93	180	256
striped searobin	3	3	0.03	0.21	0.07	.	139	9.77	120	153
striped anchovy	2	2	0.02	0.14	0.05	2	95	7.00	88	102
American eel	2	1	0.02	0.14	0.05	.	388	88.50	299	476
roughneck shrimp	2	1	0.02	0.14	0.05	.	.	.	.	
black seabass	1	1	0.01	0.07	0.02	0	210	.	210	210
butterfish	1	1	0.01	0.07	0.02	0	139	.	139	139
northern puffer	1	1	0.01	0.07	0.02	1	72	.	72	72
lined seahorse	1	1	0.01	0.07	0.02	.	49	.	49	49
mud crab spp	.	7	.	.	.	.	.	.	.	
grass shrimp spp	.	5	.	.	.	.	.	.	.	
worm spp	.	3	.	.	.	.	.	.	.	
sand shrimp	.	2	.	.	.	.	.	.	.	
soft-shell clam	.	2	.	.	.	.	.	.	.	
big-clawed snapping shrimp	.	1	.	.	.	.	.	.	.	
right-hand hermit crab spp	.	1	.	.	.	.	.	.	.	
macoma clam spp	.	1	.	.	.	.	.	.	.	
All Species Combined	11,965									

Table 53. Species composition statistics for Pocomoke Sound, December 1998.

Month - December, 1998
System - Pocomoke Sound
No. of Random Trawls Made - 11
No. of Fixed Trawls Made - 3
No. of Species - 22
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	24,159	12	69.71	1725.64	.	23,200	46	0.72	29	89
Atlantic croaker	10,416	12	30.06	744.00	99.25	9,850	61	2.28	26	340
silver perch	19	2	0.05	1.36	0.18	19	112	4.58	80	154
blue crab, juvenile female	11	6	0.03	0.79	0.10	.	57	7.98	18	118
weakfish	11	2	0.03	0.79	0.10	10	171	20.20	130	368
spot	7	2	0.02	0.50	0.07	7	133	5.63	114	153
blue crab, male	6	3	0.02	0.43	0.06	.	64	21.15	16	150
northern pipefish	4	3	0.01	0.29	0.04	.	132	17.00	102	175
Atlantic silverside	4	2	0.01	0.29	0.04	4	78	6.14	70	96
summer flounder	4	1	0.01	0.29	0.04	1	315	30.44	234	362
striped bass	3	2	0.01	0.21	0.03	0	424	44.80	335	475
blueback herring	1	1	0.00	0.07	0.01	1	66	.	66	66
black drum	1	1	0.00	0.07	0.01	.	231	.	231	231
Atlantic menhaden	1	1	0.00	0.07	0.01	0	333	.	333	333
gizzard shad	1	1	0.00	0.07	0.01	1	124	.	124	124
hogchoker	1	1	0.00	0.07	.	0	145	.	145	145
oyster toadfish	1	1	0.00	0.07	0.01	.	291	.	291	291
Atlantic cutlassfish	1	1	0.00	0.07	0.01	.	397	.	397	397
spider crab, 6 spine	1	1	0.00	0.07	0.01	.	.	.	.	
mantis shrimp	1	1	0.00	0.07	0.01	.	64	.	64	64
channel (smooth) whelk	1	1	0.00	0.07	0.01	.	.	.	.	
blue crab, adult female	1	1	0.00	0.07	0.01	.	126	.	126	126
sand shrimp	.	13	.	.	.	.	.	.	.	
moon snail	.	3	.	.	.	.	.	.	.	
mud crab spp	.	2	.	.	.	.	.	.	.	
worm spp	.	2	.	.	.	.	.	.	.	
right-hand hermit crab spp	.	1	.	.	.	.	.	.	.	
All Species Combined	34,655									

Table 54. Species composition statistics for Pocomoke Sound, March 1999.

Month - March, 1999
System - Pocomoke Sound
No. of Random Trawls Made - 11
No. of Fixed Trawls Made - 3
No. of Species - 19
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	1,185	13	81.67	84.64	.	1,185	52	0.69	32	77
spotted hake	114	7	7.86	8.14	43.02	114	106	1.67	53	155
blue crab, juvenile female	73	6	5.03	5.21	27.55	.	25	1.47	10	69
blue crab, male	19	4	1.31	1.36	7.17	.	38	5.45	16	104
blackcheek tonguefish	17	4	1.17	1.21	6.42	17	60	1.75	47	75
mantis shrimp	9	4	0.62	0.64	3.40	.	78	6.94	51	106
Atlantic menhaden	7	5	0.48	0.50	2.64	6	47	0.94	44	51
alewife	6	3	0.41	0.43	2.26	6	121	5.29	105	141
northern pipefish	5	3	0.34	0.36	1.89	.	108	8.74	82	123
blueback herring	3	3	0.21	0.21	1.13	3	90	3.71	85	97
northern searobin	3	3	0.21	0.21	1.13	3	67	3.18	61	72
Atlantic croaker	2	2	0.14	0.14	0.75	2	55	6.00	49	61
blue crab, adult female	2	1	0.14	0.14	0.75	.	139	20.00	119	159
summer flounder	1	1	0.07	0.07	0.38	0	302	.	302	302
American shad	1	1	0.07	0.07	0.38	1	163	.	163	163
striped bass	1	1	0.07	0.07	0.38	0	315	.	315	315
hogchoker	1	1	0.07	0.07	.	0	102	.	102	102
oyster toadfish	1	1	0.07	0.07	0.38	.	63	.	63	63
horseshoe crab	1	1	0.07	0.07	0.38	.	306	.	306	306
sand shrimp	.	12	.	.	.	.	.	.	.	
jellyfish spp	.	11	.	.	.	.	.	.	.	
right-hand hermit crab spp	.	4	.	.	.	.	.	.	.	
mud crab spp	.	3	.	.	.	.	.	.	.	
mysid shrimp	.	3	.	.	.	.	.	.	.	
glassy lyonsia	.	3	.	.	.	.	.	.	.	
little surf clam	.	3	.	.	.	.	.	.	.	
moon snail	.	2	.	.	.	.	.	.	.	
worm spp	.	1	.	.	.	.	.	.	.	
All Species Combined	1,451									

Table 55. Species composition statistics for Pocomoke Sound, May 1999.

Month - May, 1999
System - Pocomoke Sound
No. of Random Trawls Made - 11
No. of Fixed Trawls Made - 3
No. of Species - 22
Adjusted Percent of Catch Excludes Bay Anchovy and Hogchoker

Species	Number of Fish (All)	Frequency	Percent of Catch	Catch Per Trawl	Adjusted Percent of Catch	Number of Fish YOY	Average Length (mm)	Standard Error (length)	Minimum Length (mm)	Maximu Lengt (m
bay anchovy	691	8	50.44	49.36	.	680	62	0.97	43	88
Atlantic croaker	223	10	16.28	15.93	35.91	0	238	2.04	158	340
blue crab, juvenile female	98	13	7.15	7.00	15.78	.	53	1.83	18	100
spotted hake	71	8	5.18	5.07	11.43	71	130	3.47	68	193
hogchoker	58	7	4.23	4.14	.	0	115	2.07	88	154
northern searobin	43	10	3.14	3.07	6.92	43	71	1.73	50	94
weakfish	37	6	2.70	2.64	5.96	9	252	6.58	152	310
spot	35	11	2.55	2.50	5.64	0	179	2.25	156	206
blue crab, male	34	10	2.48	2.43	5.48	.	58	3.45	27	123
Atlantic herring	27	4	1.97	1.93	4.35	.	66	1.51	45	77
blackcheek tonguefish	17	8	1.24	1.21	2.74	13	91	8.39	52	162
summer flounder	8	4	0.58	0.57	1.29	0	277	8.35	234	312
northern pipefish	8	4	0.58	0.57	1.29	.	135	4.49	119	156
silver perch	4	2	0.29	0.29	0.64	1	174	7.47	158	194
American eel	4	1	0.29	0.29	0.64	.	336	13.19	306	362
blue crab, adult female	3	2	0.22	0.21	0.48	.	134	3.06	128	138
smallmouth flounder	2	2	0.15	0.14	0.32	2	44	0.50	43	44
Atlantic menhaden	2	1	0.15	0.14	0.32	0	184	0.00	184	184
lined seahorse	2	1	0.15	0.14	0.32	.	88	6.50	81	94
winter flounder	1	1	0.07	0.07	0.16	.	33	.	33	33
right-hand hermit crab spp	1	1	0.07	0.07	0.16	.	.	.	.	
quahog clam	1	1	0.07	0.07	0.16	.	.	.	.	
sand shrimp	.	11	.	.	.	.	.	.	.	
jellyfish spp	.	9	.	.	.	.	.	.	.	
mud crab spp	.	7	.	.	.	.	.	.	.	
grass shrimp spp	.	7	.	.	.	.	.	.	.	
mysid shrimp	.	7	.	.	.	.	.	.	.	
worm spp	.	5	.	.	.	.	.	.	.	
Amphipod spp	.	4	.	.	.	.	.	.	.	
little surf clam	.	4	.	.	.	.	.	.	.	
transverse ark	.	3	.	.	.	.	.	.	.	
drill & snail spp	.	2	.	.	.	.	.	.	.	
skeleton shrimp spp	.	1	.	.	.	.	.	.	.	
soft-shell clam	.	1	.	.	.	.	.	.	.	
glassy lyonsia	.	1	.	.	.	.	.	.	.	
oyster, common	.	1	.	.	.	.	.	.	.	
All Species Combined	1,370									

FIGURES

Figure 1. The VIMS Trawl Survey random stratified design of the Chesapeake Bay. Transect lines indicate geographic regions as designated below.
'*' indicates areas not presently sampled.

KEY:	Chesapeake Bay	B1	Bottom Bay
		B2	Lower Bay
		B3	Upper Bay
	*	B4	Top Bay
	James River	J1	Bottom James
		J2	Lower James
		J3	Upper James
		J4	Top James
	*	J5	Freshwater James 1
	*	J6	Freshwater James 2
	*	JE	Elizabeth River
	*	JC	Chickahominy River
	York River	Y1	Bottom York
		Y2	Lower York
		Y3	Upper York
		Y4	Top York (lower Pamunkey River)
	*	PM	Pamunkey River
	*	MP1	Lower Mattaponi
	*	MP2	Upper Mattaponi
	Rappahannock River	R1	Bottom Rappahannock
		R2	Lower Rappahannock
		R3	Upper Rappahannock
		R4	Top Rappahannock
	*	R5	Freshwater Rappahannock
	*	RC	Corotoman River
	Potomac River *	PO1	Lower Potomac
	*	PO2	Upper Potomac
	Mobjack Bay	MB (re-established as of July 1998)	
	Atlantic Ocean *	AT	
	Piankatank River	PK (re-established as of July 1998)	
	Pocomoke Sound	CP (re-established as of July 1998)	
	Great Wicomico River	GW (as of July 1998)	

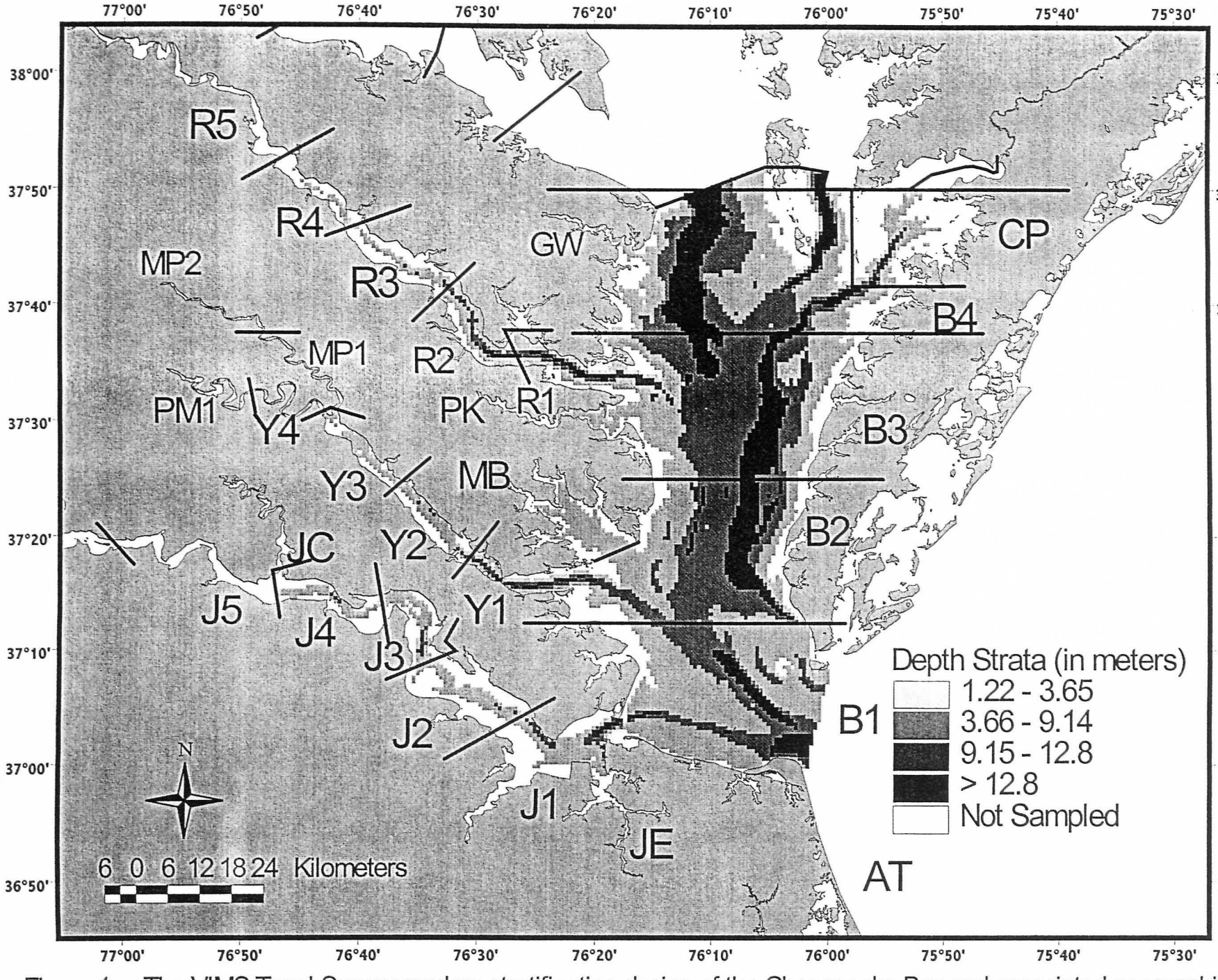


Figure 1. The VIMS Trawl Survey random stratification design of the Chesapeake Bay and associated geographic regions.

Figure 2. Sampling changes of the VIMS Trawl Survey, 1955-99. See Table 9 for full description of gears, vessels and sampling design.

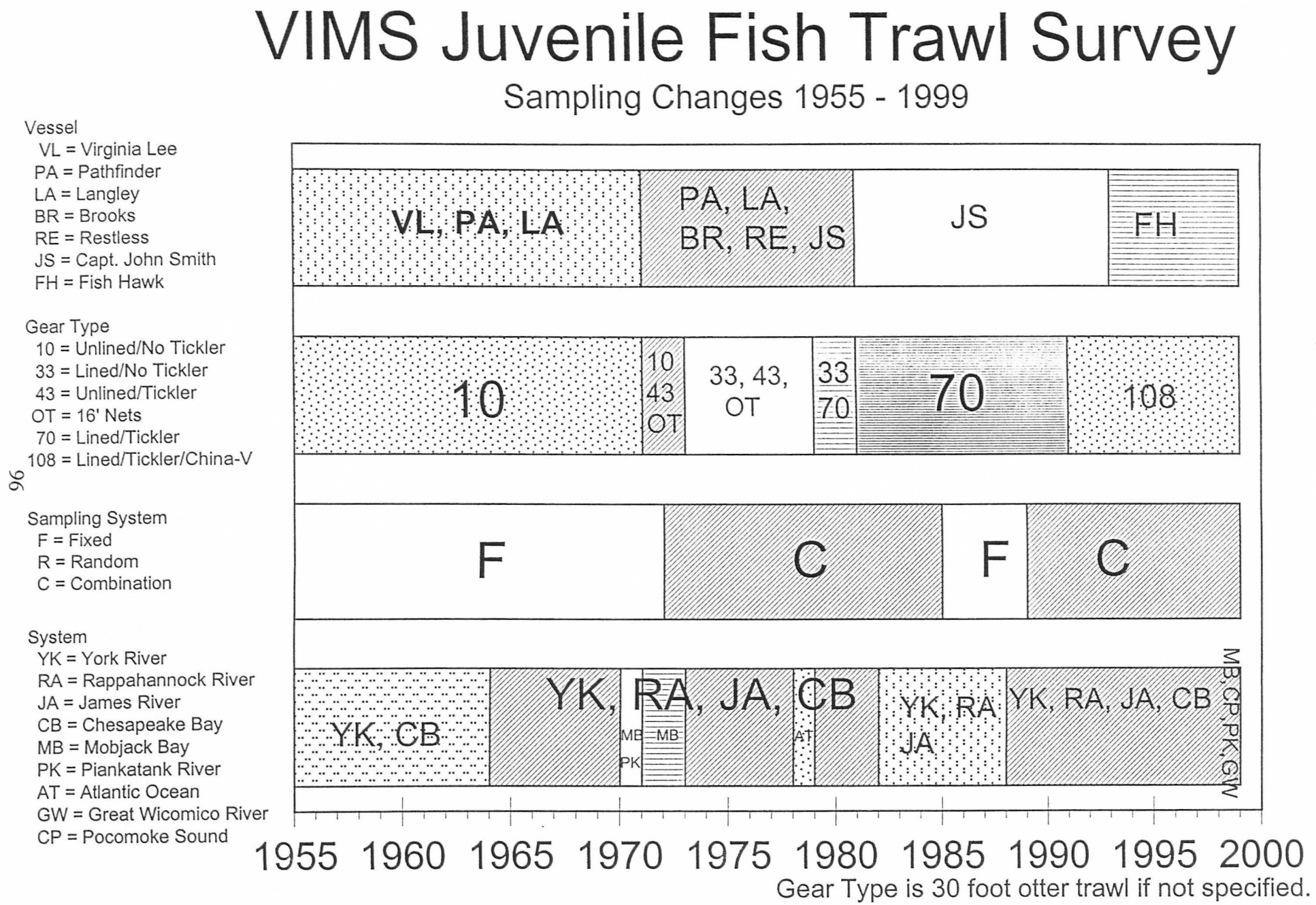


Figure 2. Sampling system, design, and gear changes for the VIMS trawl survey, 1955-1999.

Figure 3. Annual juvenile abundance indices for spot, Atlantic croaker, weakfish, and summer flounder. Bay-River Indices (BRI) are calculated for the Bay and the mid-channel transect surveys (1988-1998) as well as the historic channel transects of the tributaries (1979-1998).

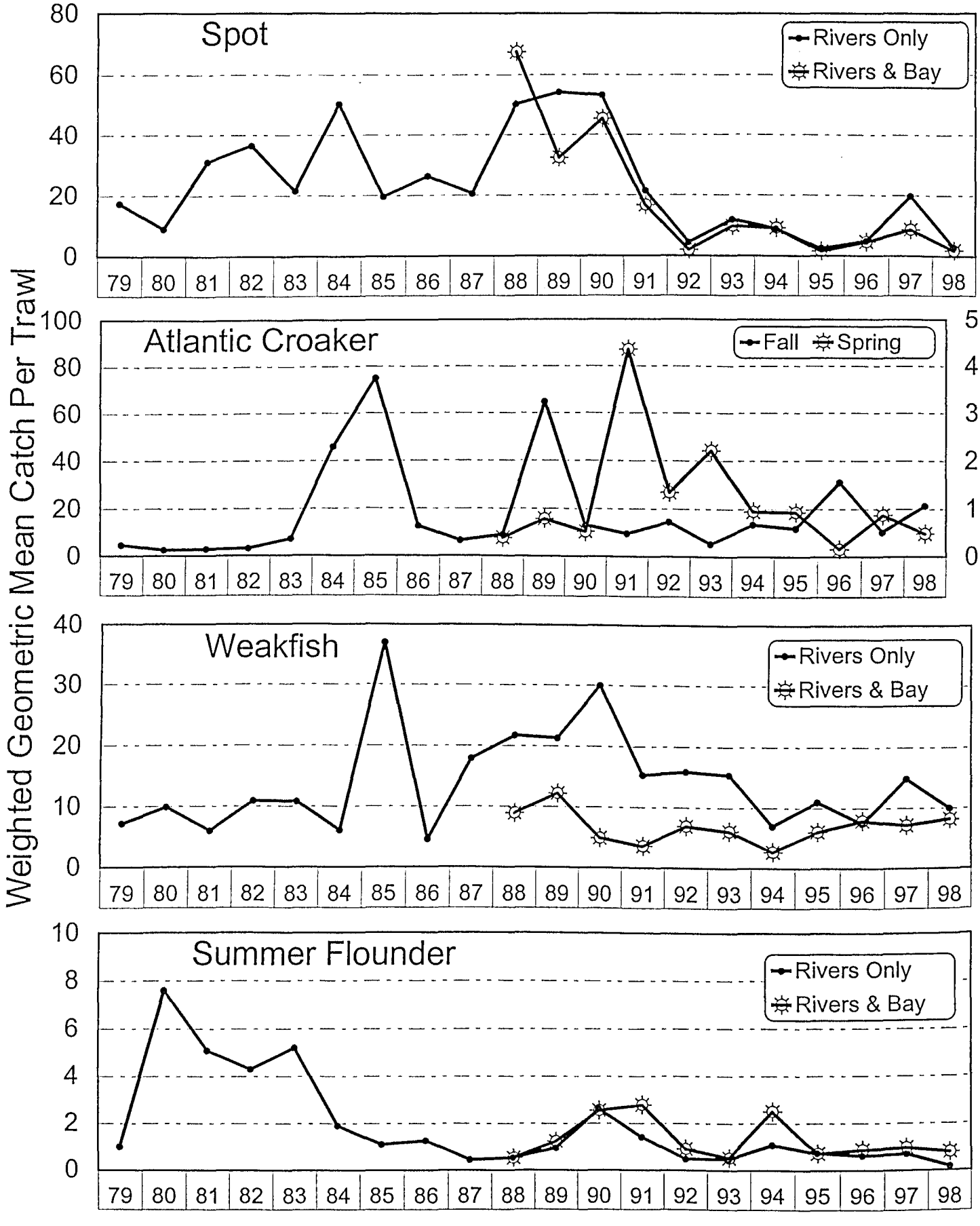

Spot
Rivers Only
Rivers & Bay
Atlantic Croaker
Fall
Spring
Weakfish
Rivers Only
Rivers & Bay
Summer Flounder
Rivers Only
Rivers & Bay
Weighted Geometric Mean Catch Per Trawl
Year Class
79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98

Figure 3.

Figure 4. Annual juvenile abundance indices for black sea bass, scup, white perch (both age 1+ and y-o-y) and striped bass. Bay-River Indices (BRI) are calculated for the Bay and the mid-channel transect surveys (1988-1998) as well as the historic channel transects of the tributaries (1979-1998).

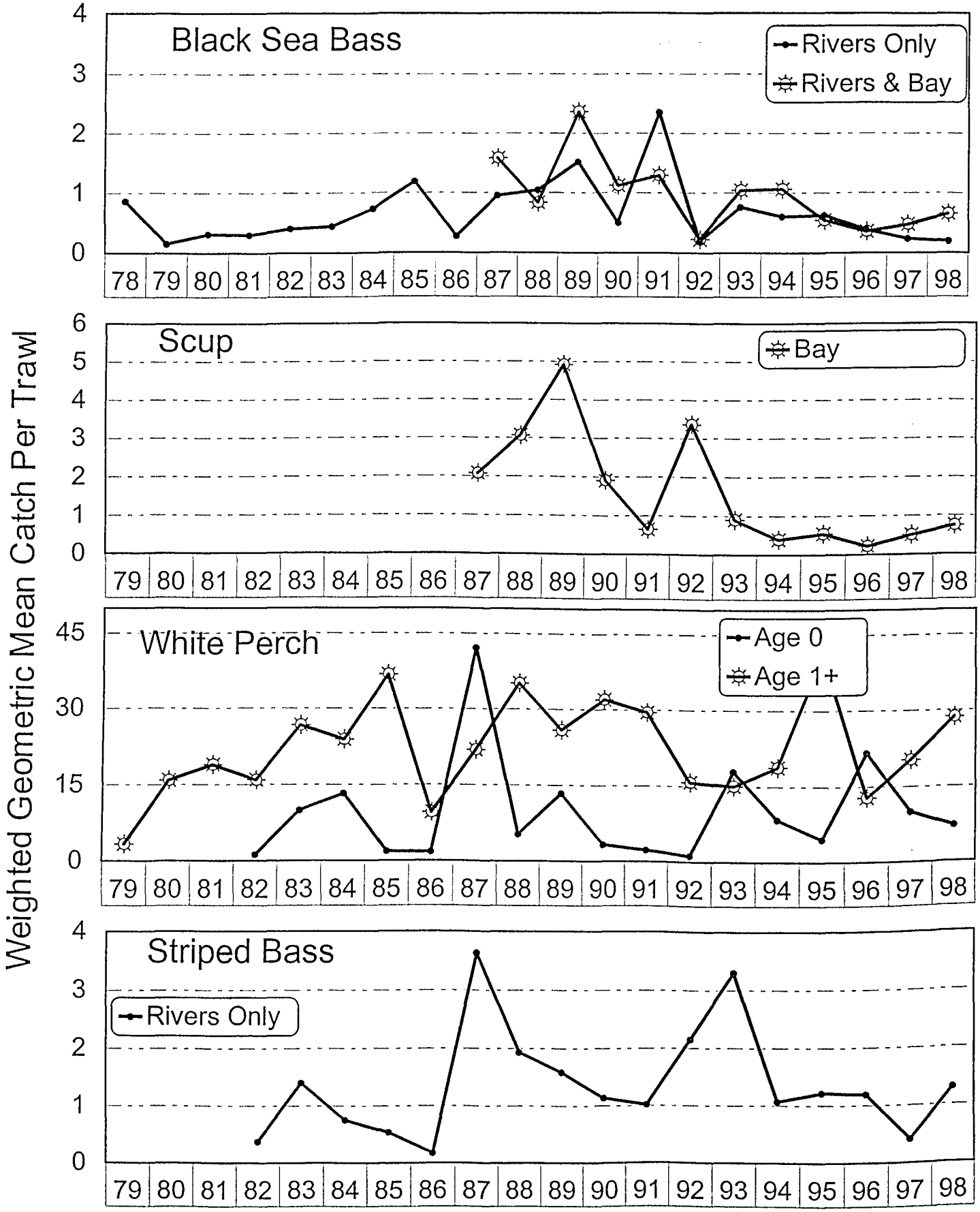

Black Sea Bass
Rivers Only
Rivers & Bay
Scup
Bay
White Perch
Age 0
Age 1+
Striped Bass
Rivers Only
Weighted Geometric Mean Catch Per Trawl
Year Class
78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98

Figure 4.

Figure 5. Annual juvenile abundance indices for white and channel catfish, northern puffer, and silver perch. Bay-River Indices (BRI) are calculated for the Bay and the mid-channel transect surveys (1988-1998) as well as the historic channel transects of the tributaries (1979-1998).

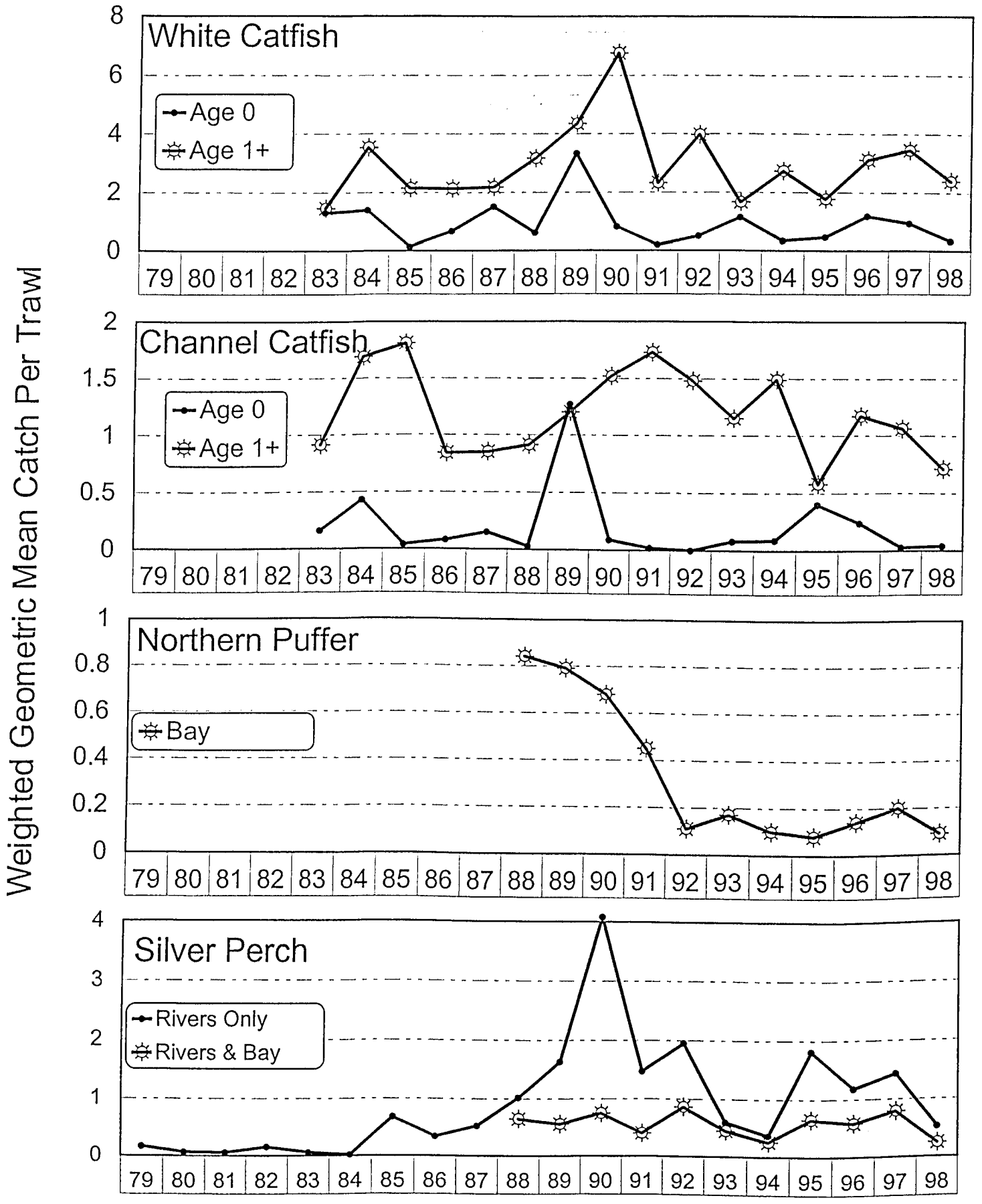

White Catfish
Age 0
Age 1+
Channel Catfish
Age 0
Age 1+
Northern Puffer
Bay
Silver Perch
Rivers Only
Rivers & Bay
Weighted Geometric Mean Catch Per Trawl
Year Class
79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98

Figure 5.

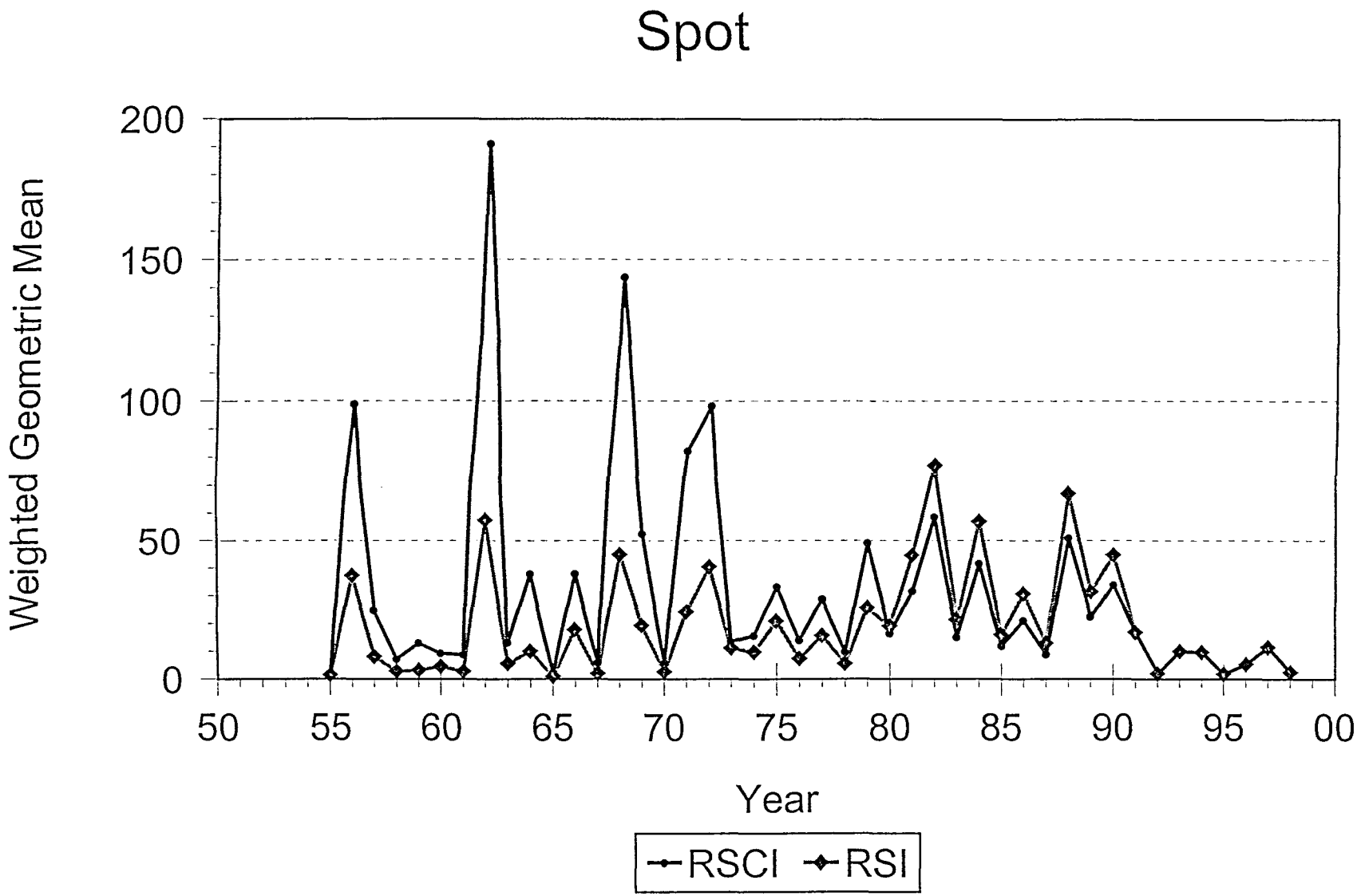


Figure 6. Y-O-Y spot random stratified (RSI) and random stratified converted (RSCI) indices.

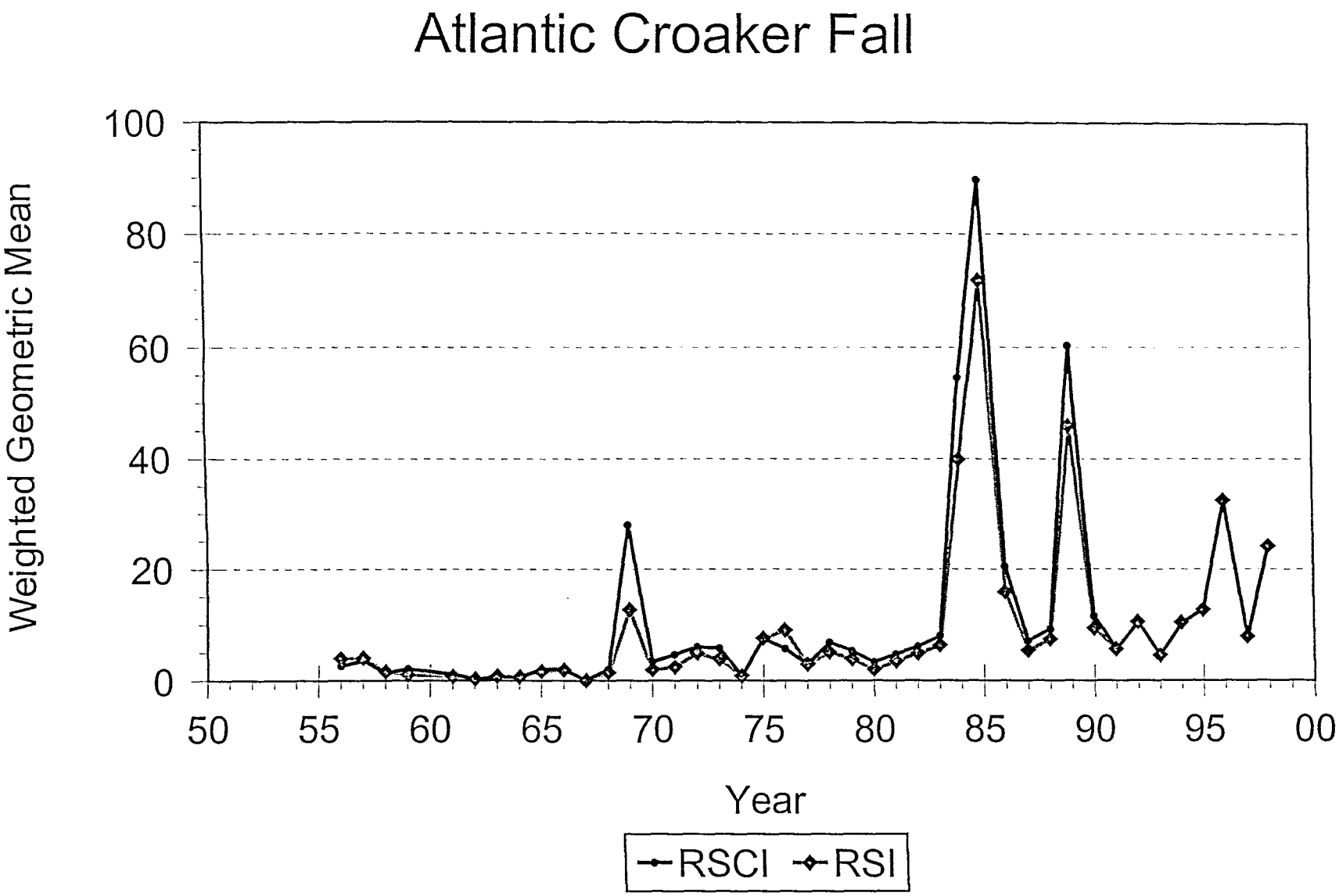


Figure 7. Fall Y-O-Y Atlantic croaker random stratified (RSI) and random stratified converted (RSCI) indices.

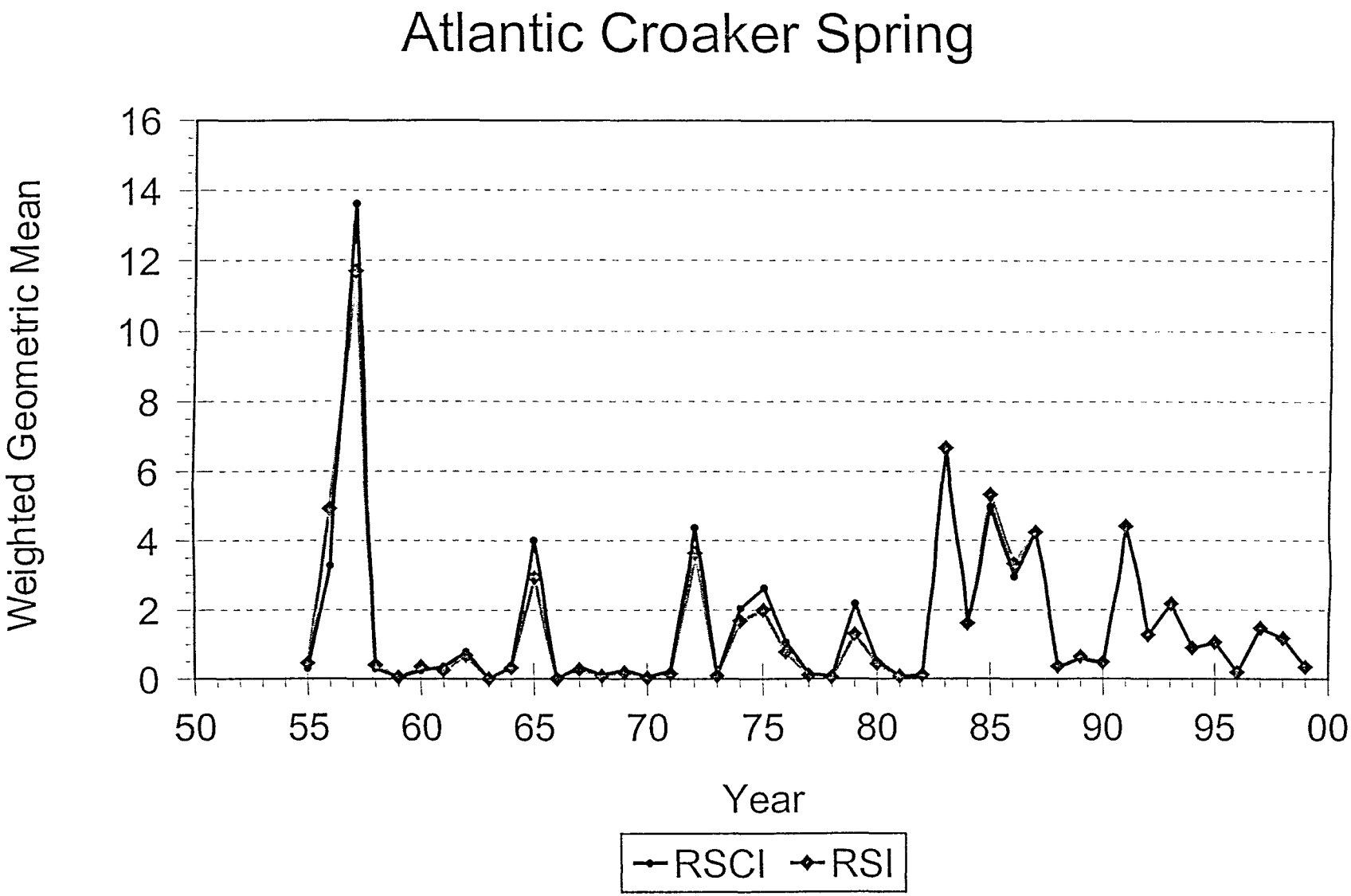


Figure 8. Spring Y-O-Y Atlantic croaker random stratified (RSI) and random stratified converted (RSCI) indices.

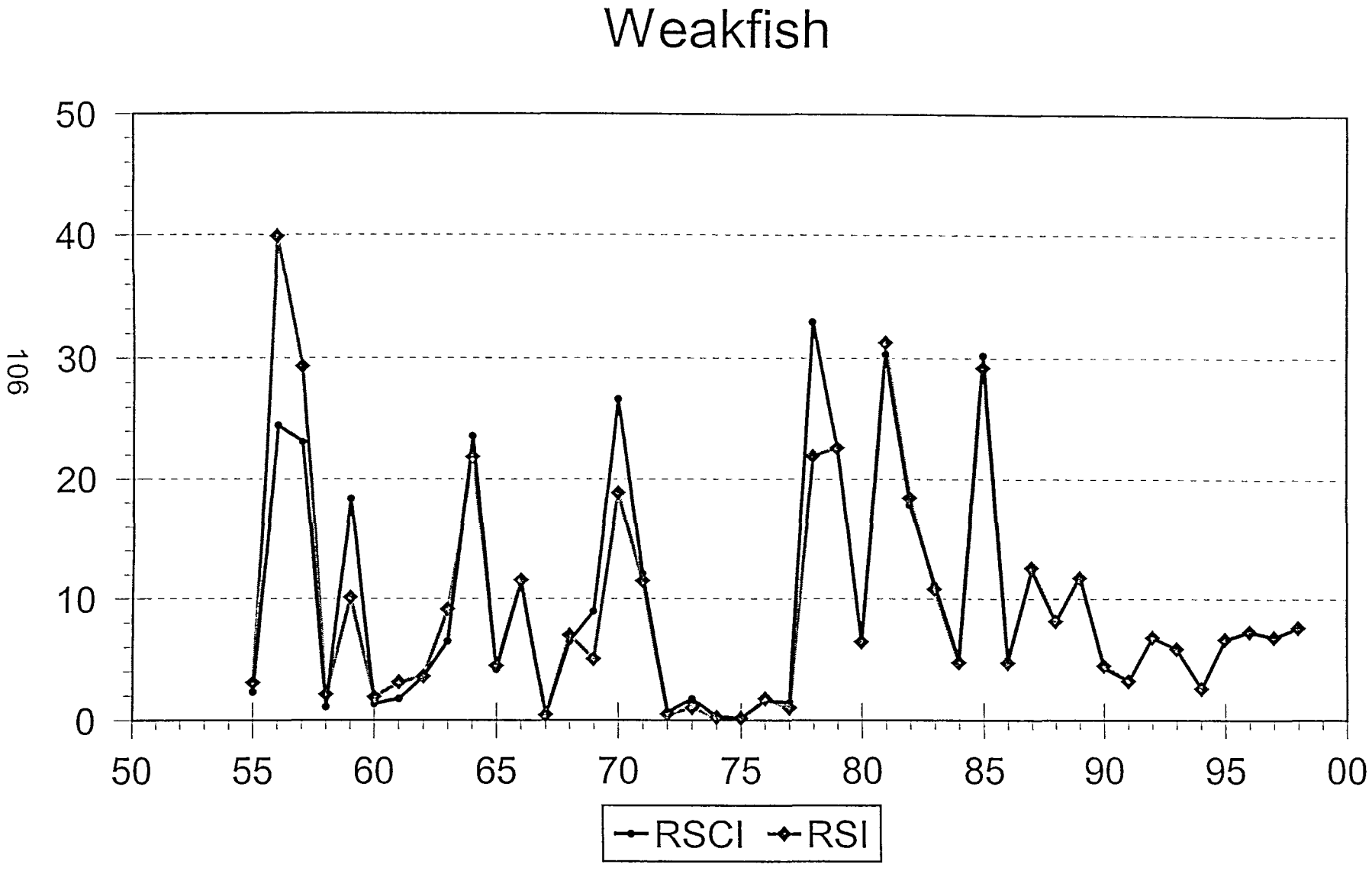


Figure 9. Y-O-Y weakfish random stratified (RSI) and random stratified converted (RSCI) indices.

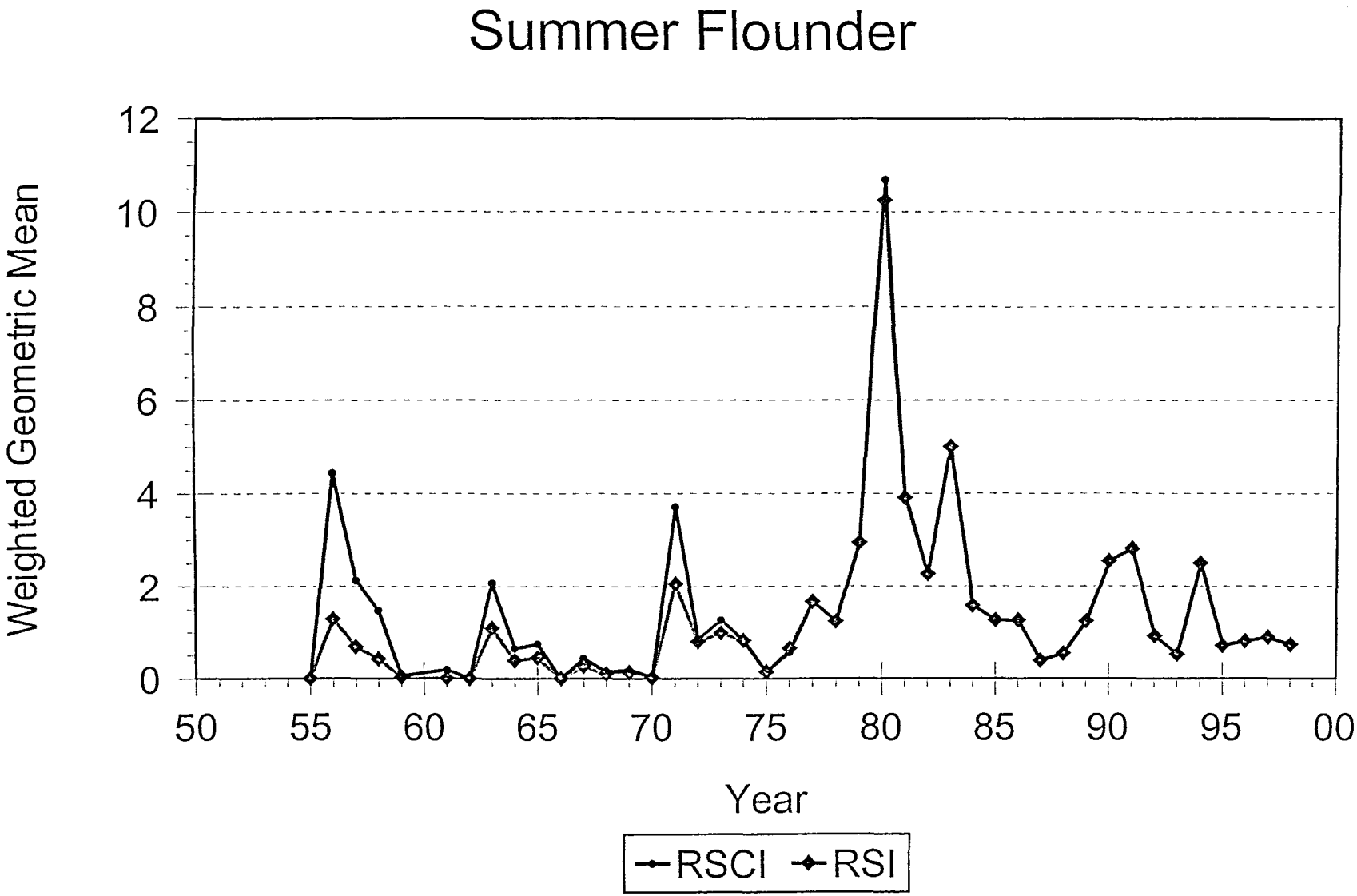


Figure 10. Y-O-Y summer flounder random stratified (RSI) and random stratified converted (RSCI) indices.

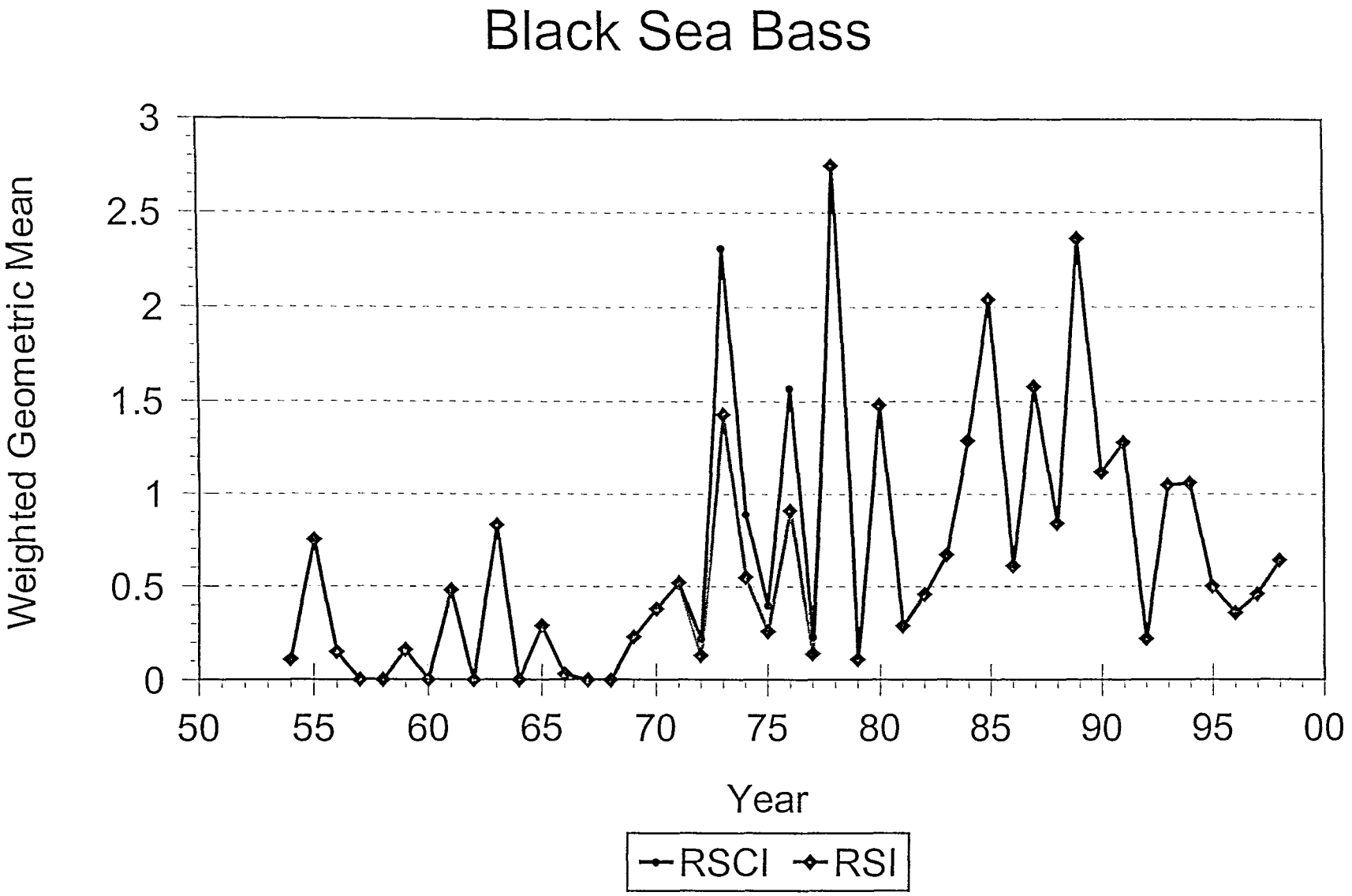


Figure 11. Y-O-Y black sea bass random stratified (RSI) and random stratified converted (RSCI) indices.

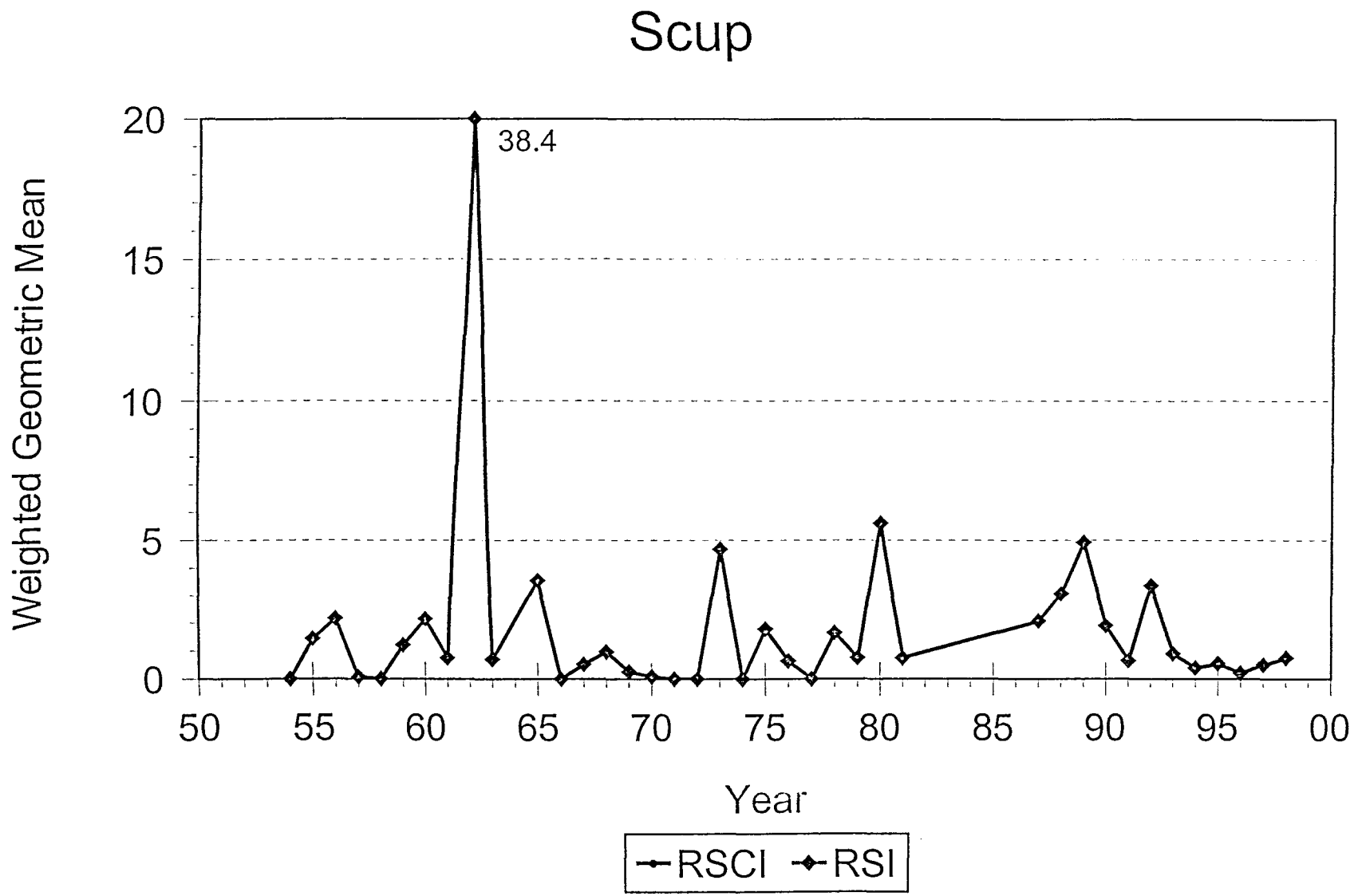


Figure 12. Y-O-Y Scup random stratified (RSI) and random stratified converted (RSCI) indices.

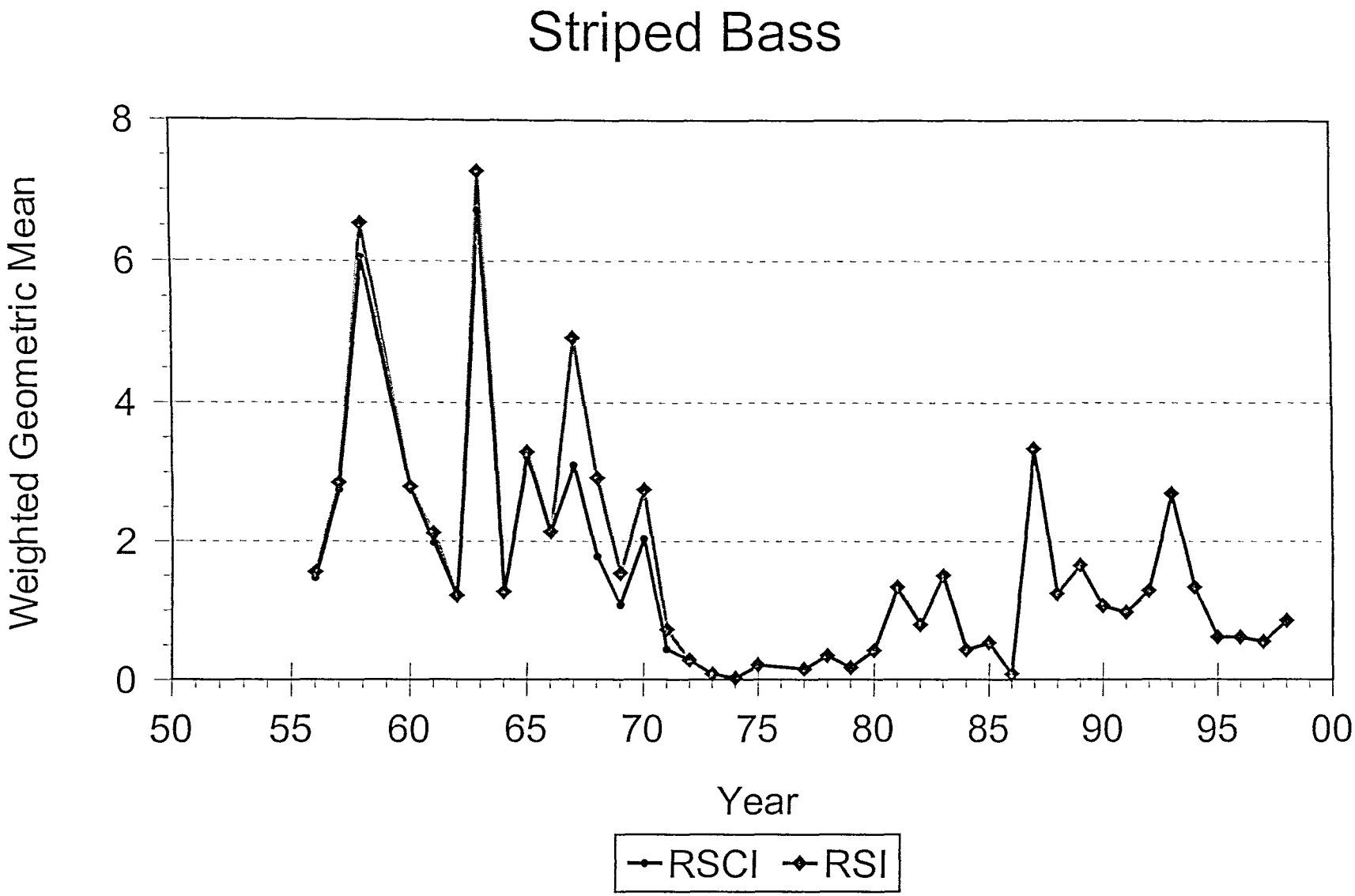


Figure 13. Y-O-Y striped bass random stratified (RSI) and random stratified converted (RSCI) indices.

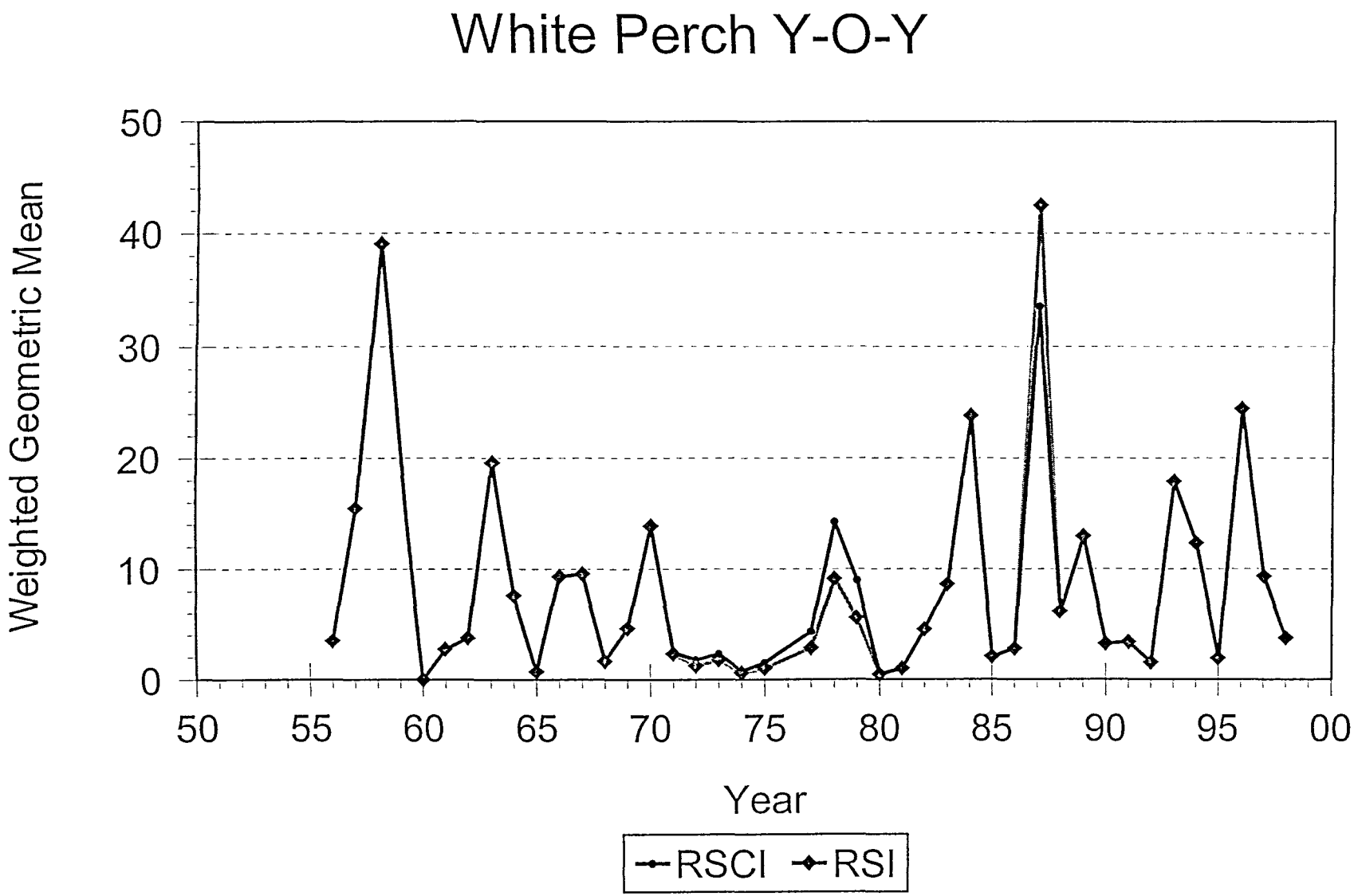


Figure 14. Y-O-Y white perch random stratified (RSI) and random stratified converted (RSCI) indices.

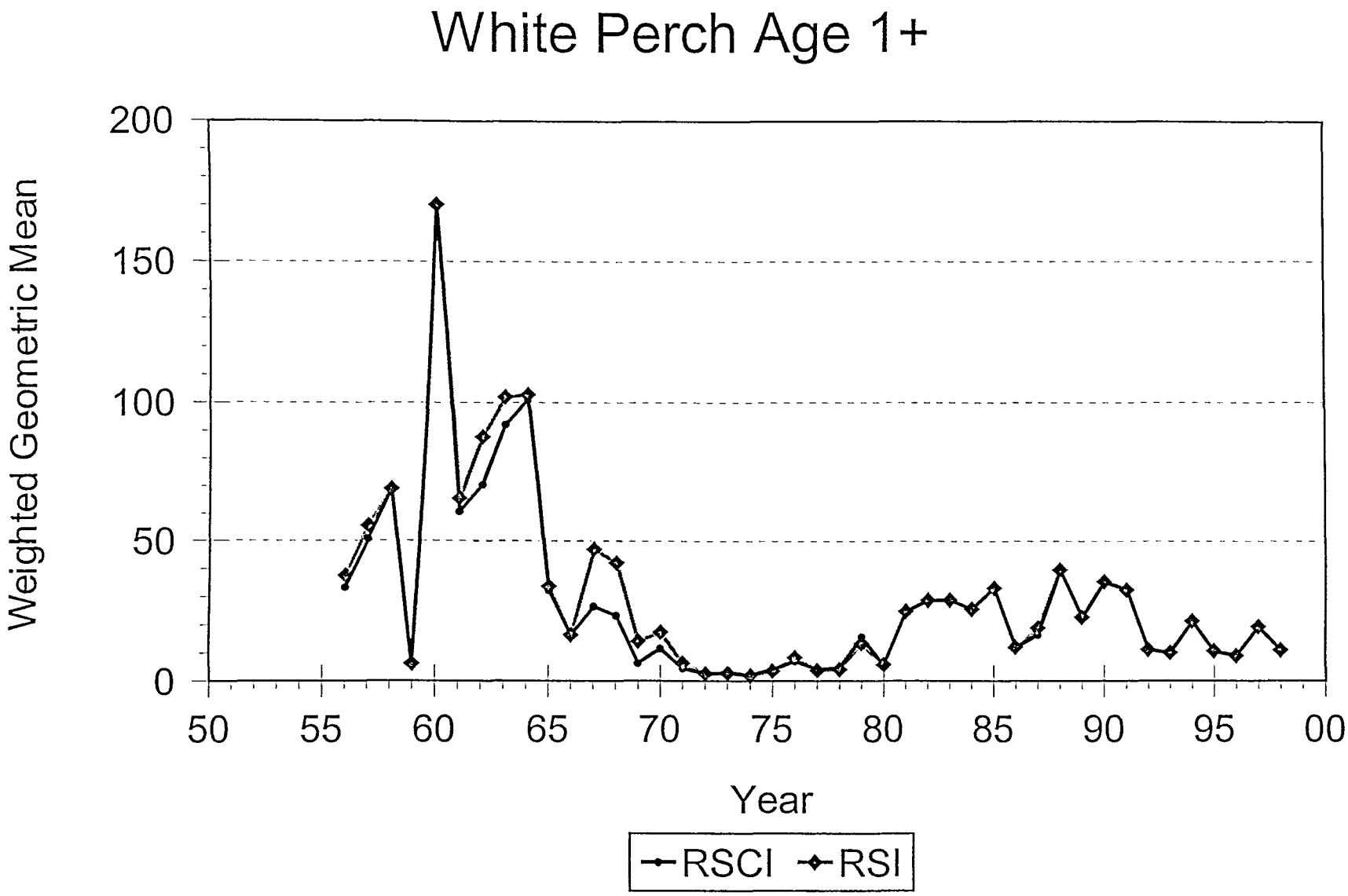


Figure 15. Age 1+ white perch random stratified (RSI) and random stratified converted (RSCI) indices.

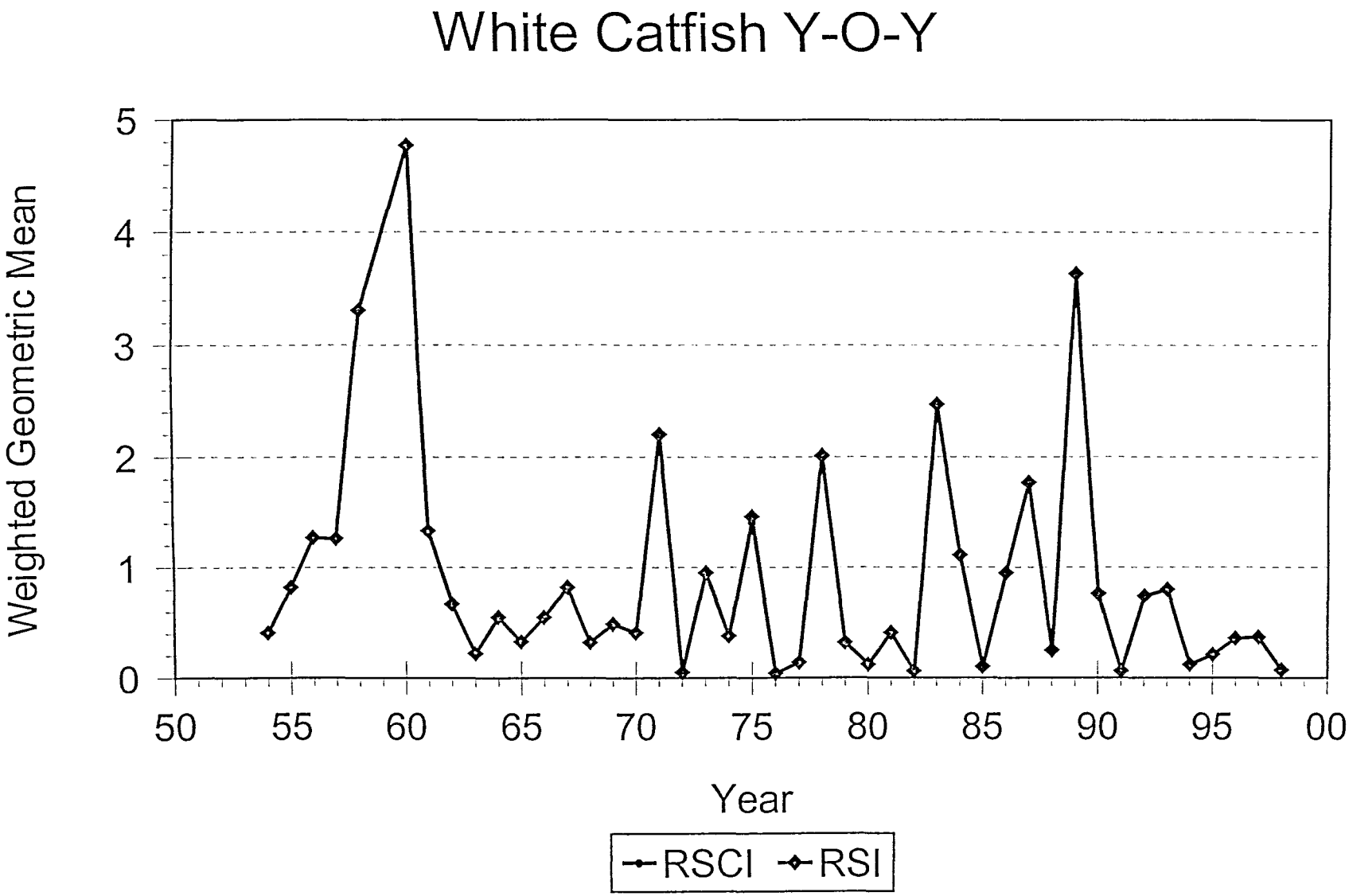


Figure 16. Y-O-Y white catfish random stratified (RSI) and random stratified converted (RSCI) indices.

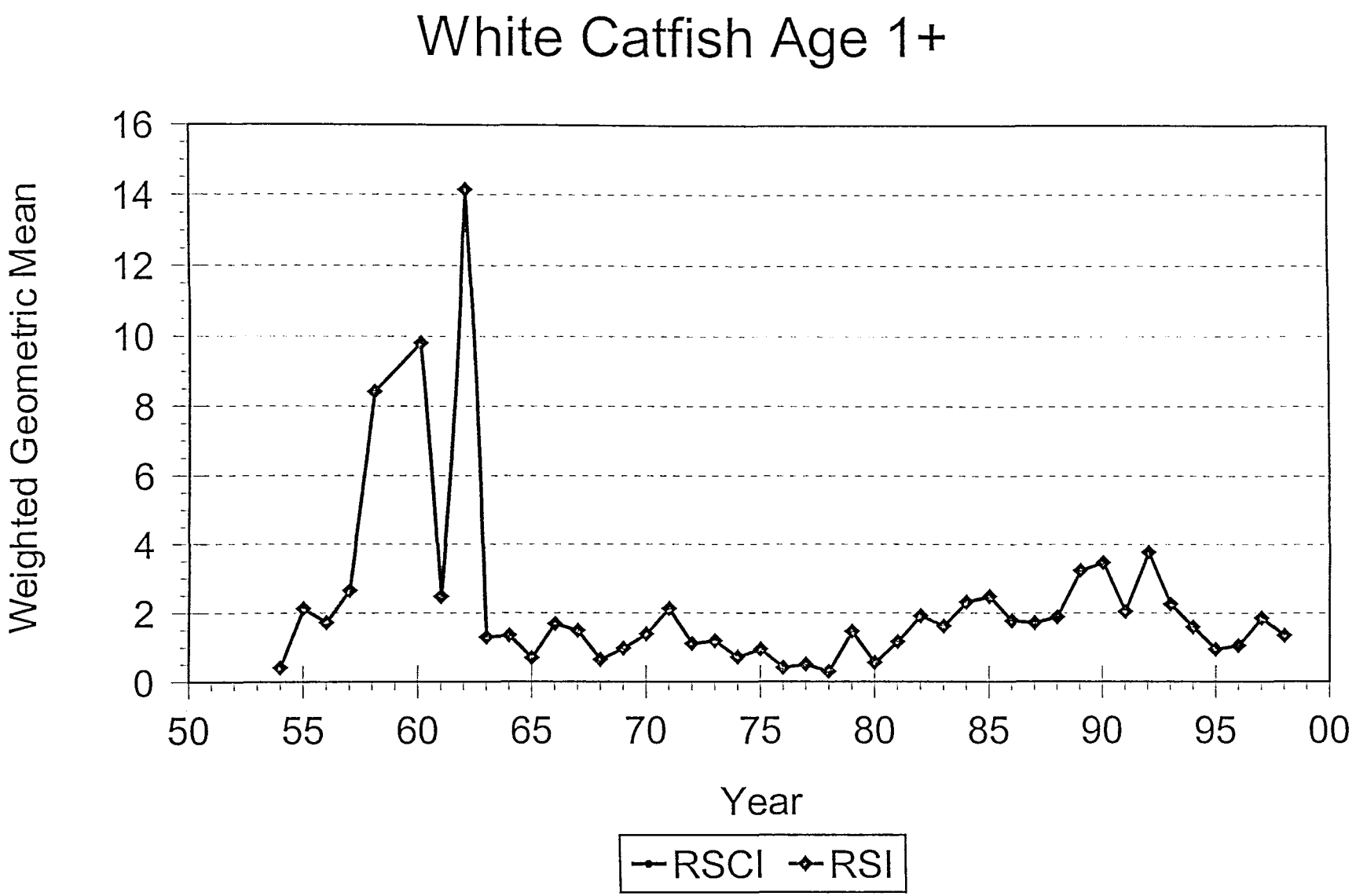


Figure 17. Age 1+ white catfish random stratified (RSI) and random stratified converted (RSCI) indices.

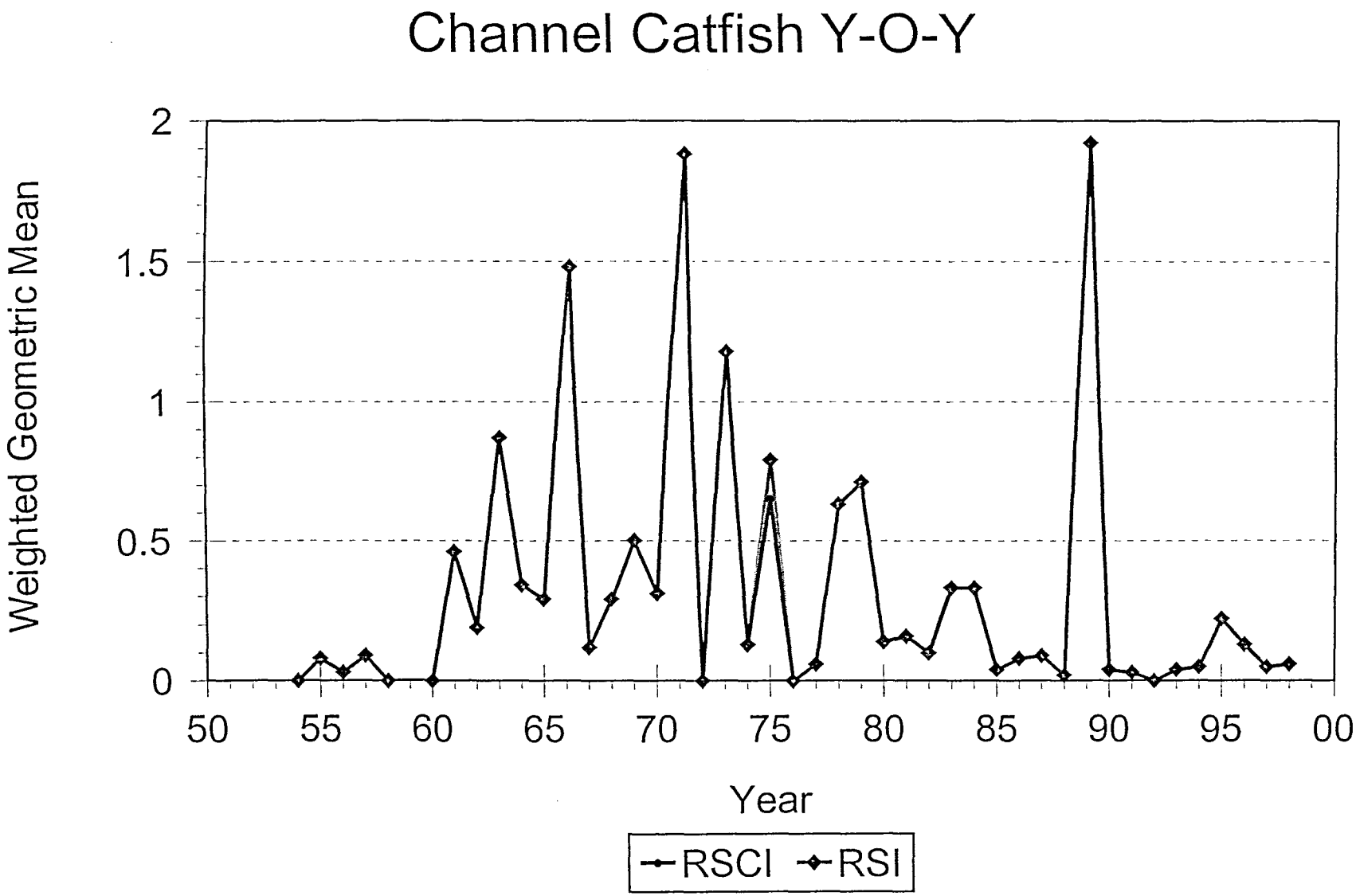


Figure 18. Y-O-Y channel catfish random stratified (RSI) and random stratified converted (RSCI) indices.

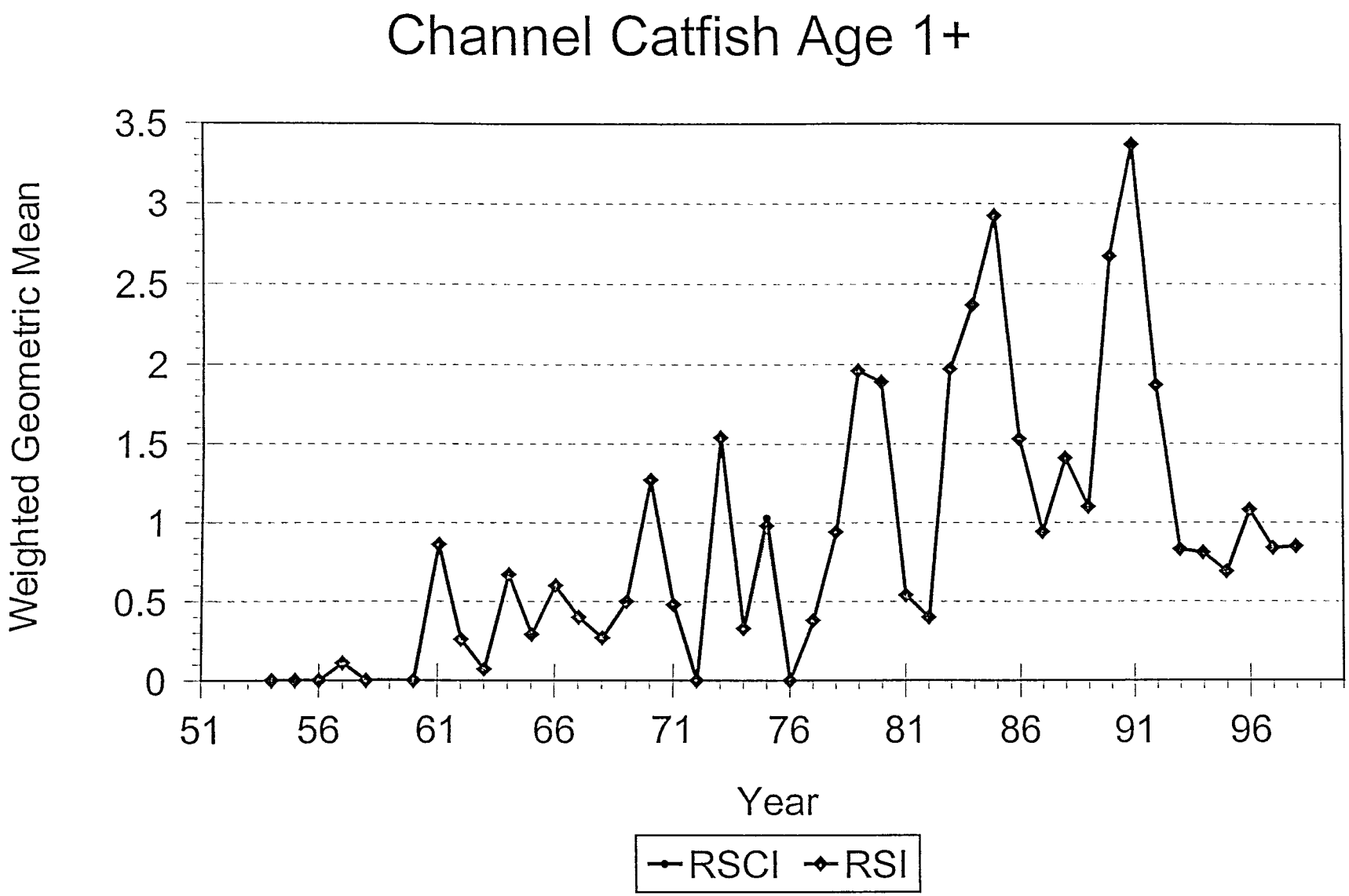


Figure 19. Age 1+ channel catfish random stratified (RSI) and random stratified converted (RSCI) indices.

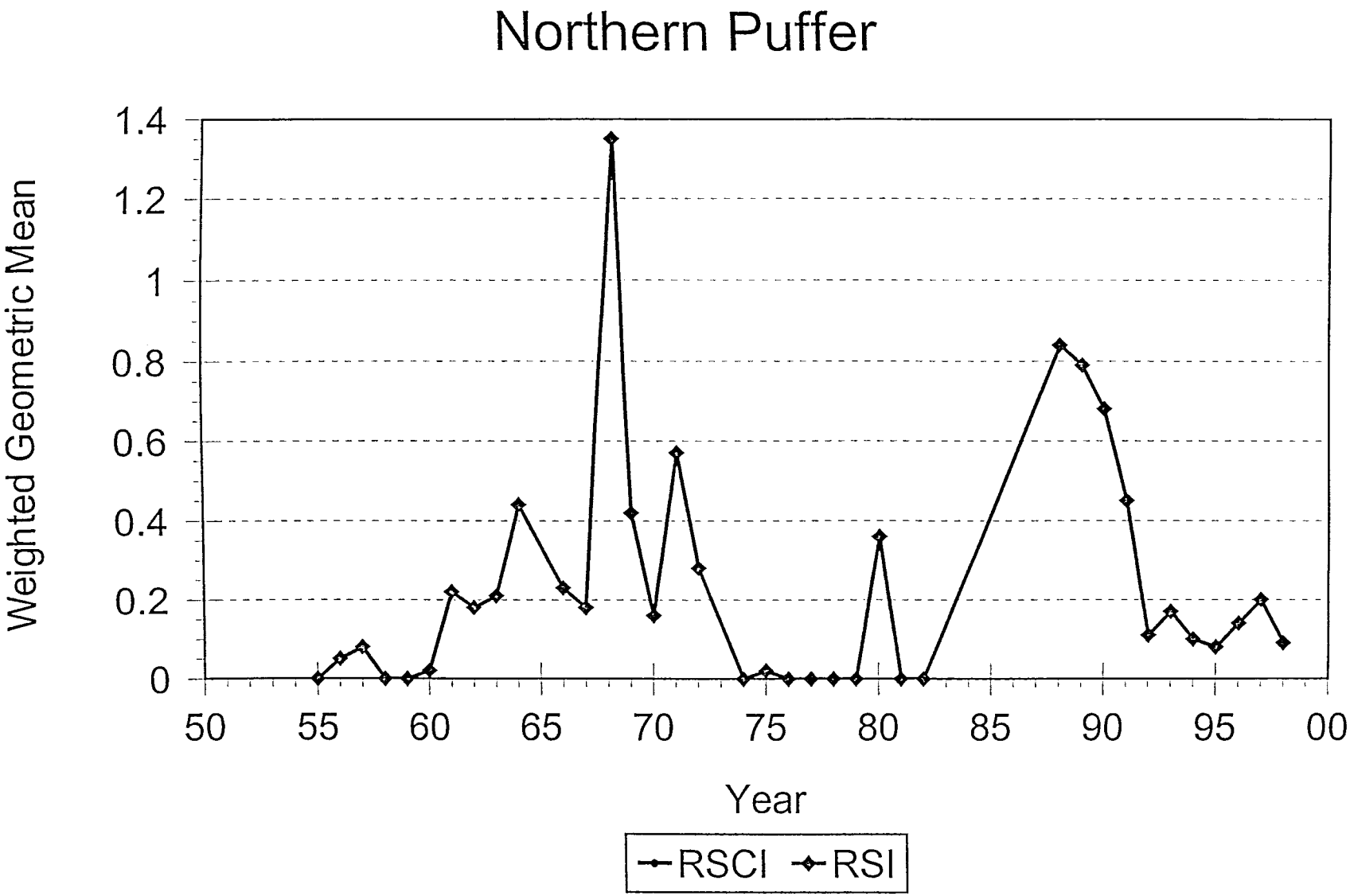


Figure 20. Y-O-Y northern puffer random stratified (RSI) and random stratified converted (RSCI) indices.

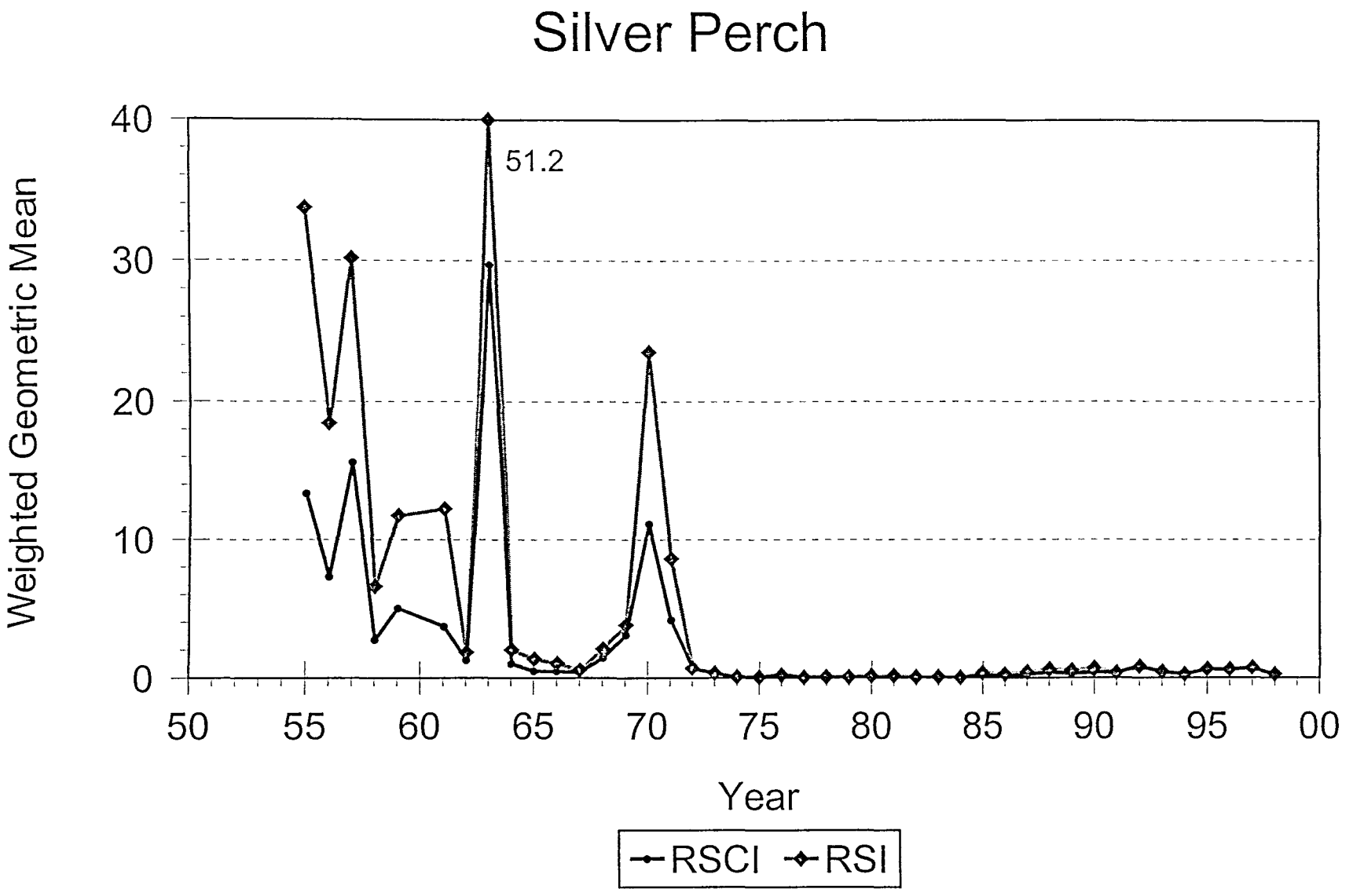


Figure 21. Y-O-Y silver perch random stratified (RSI) and random stratified converted (RSCI) indices.

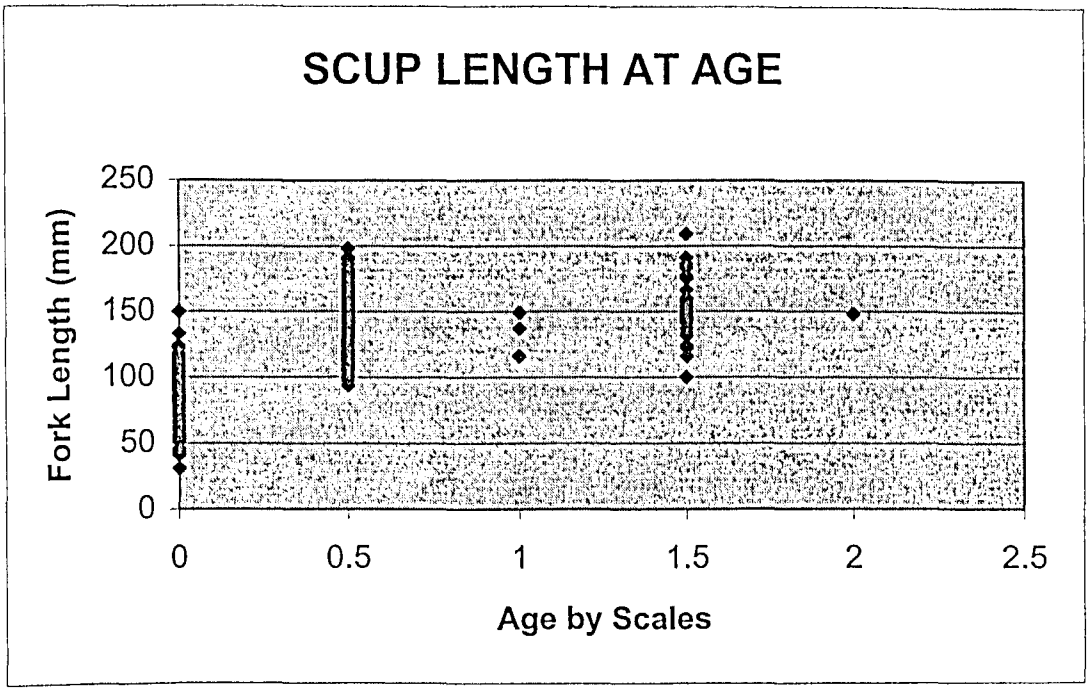


Figure 22a. Scup collected from 1992 through 1997 and aged using scales (n = 467). An age of 0.5 was assigned to those scales with a large amount of growth but no annulus showing. Scales with growth beyond the first annulus were assigned the age of 1.5.

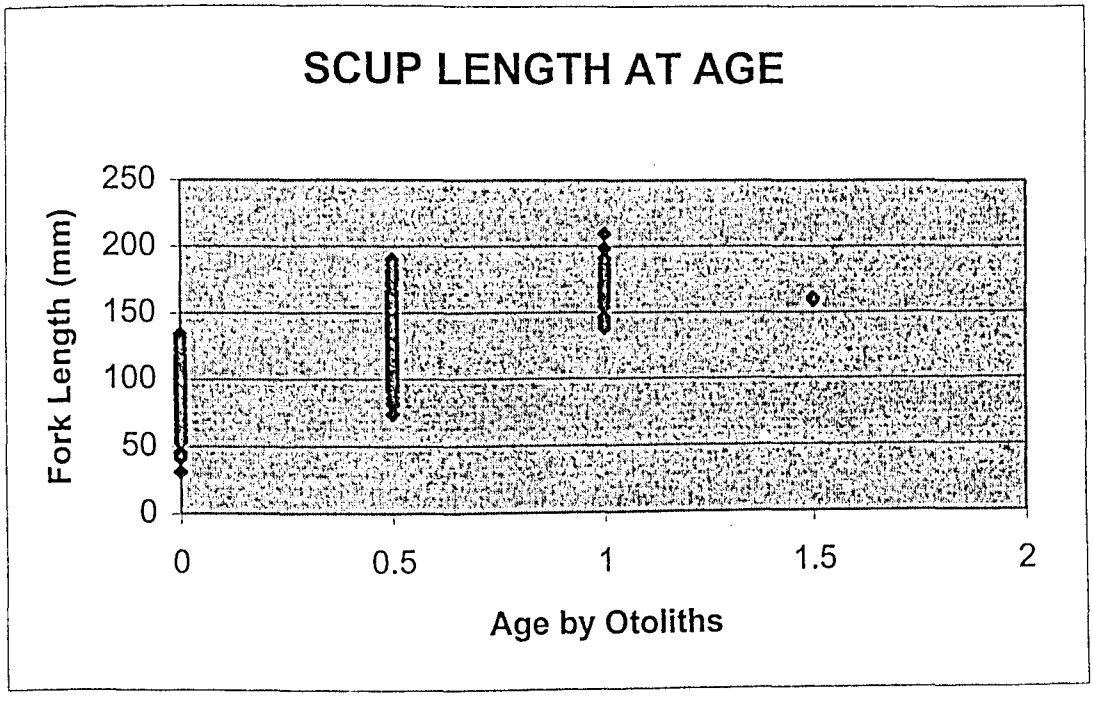


Figure 22b. Scup collected from 1992 through 1997 and aged using otoliths (n = 409). Otoliths with an area of growth around the nucleus were called age 0.5. Age 1 was assigned to otoliths which showed a lengthening posteriorly in which a partial annulus was clearly visible. Otoliths which were thicker and showed growth beyond the partial annulus were called age 1.5.

Source: VIMS Trawl Survey, W. Lowery.

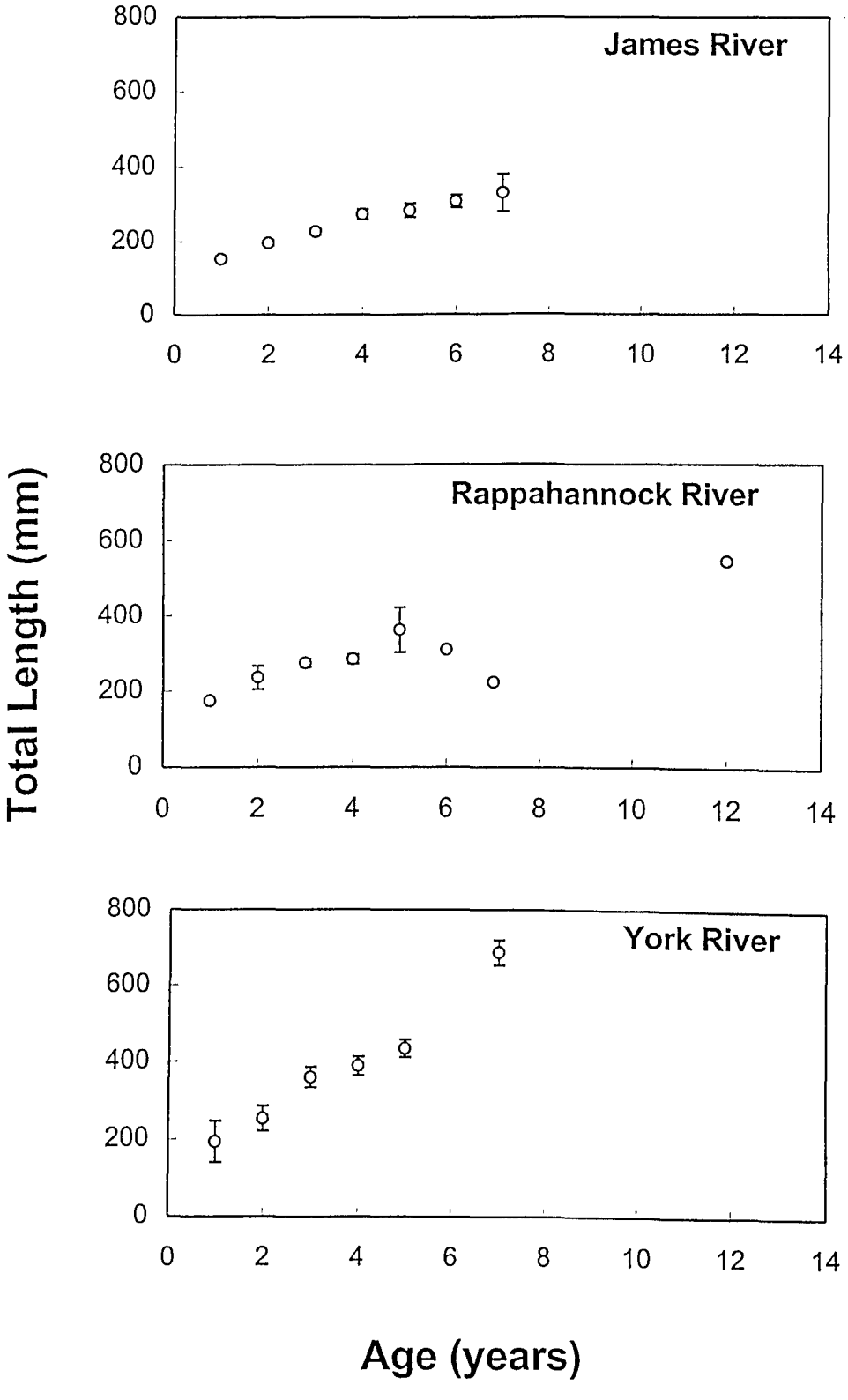


Figure 23 . Mean total length at age for American eels collected from the James, Rappahannock, and York Rivers, Virginia, 1997-1999. Vertical bars represent standard errors. Source: VIMS Trawl Survey, S.J. Owens.

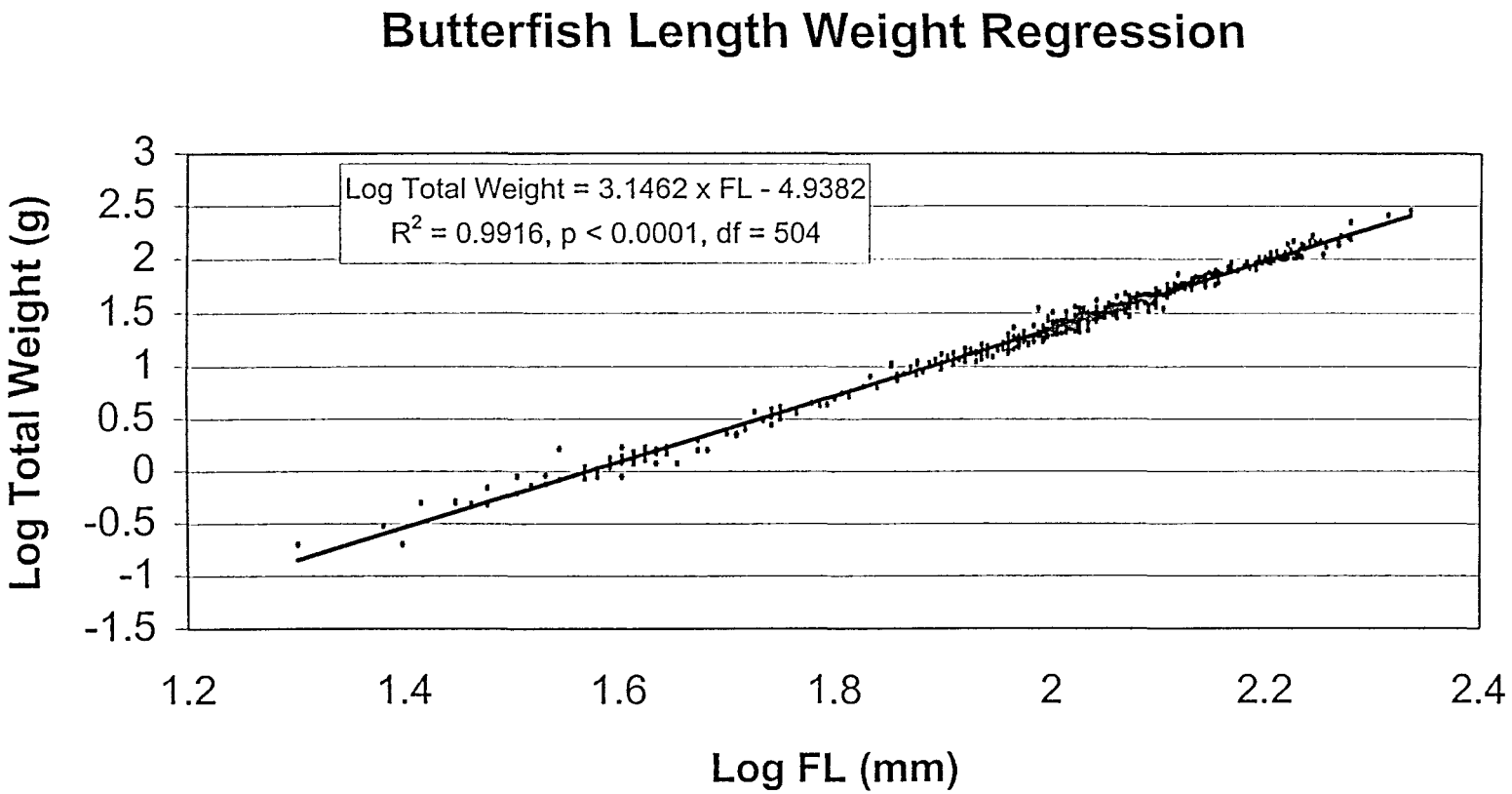


Figure 24. Butterfish length weight regression.
Source: VIMS Trawl Survey, T. Mathes

Figure 25. Estimates of relative abundance for juvenile spot, croaker, weakfish, and summer flounder from quarterly sampling performed between July 1998 and June 1999 on the Pocomoke Sound (CP), Mobjack Bay (MB), Great Wicomico (GW) and Piankatank (PK) Rivers. Other species were not caught in high enough abundance for analysis purposes.

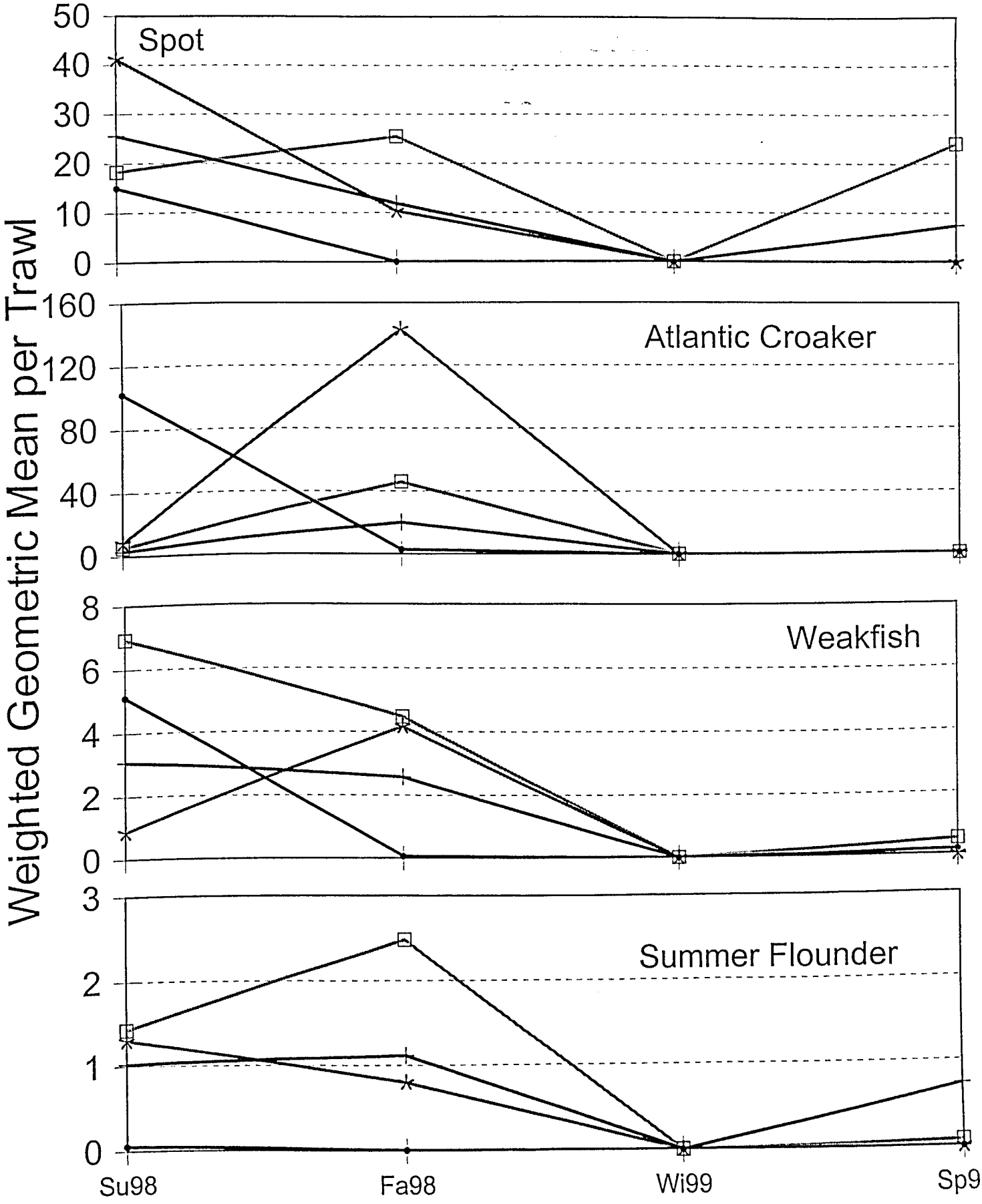
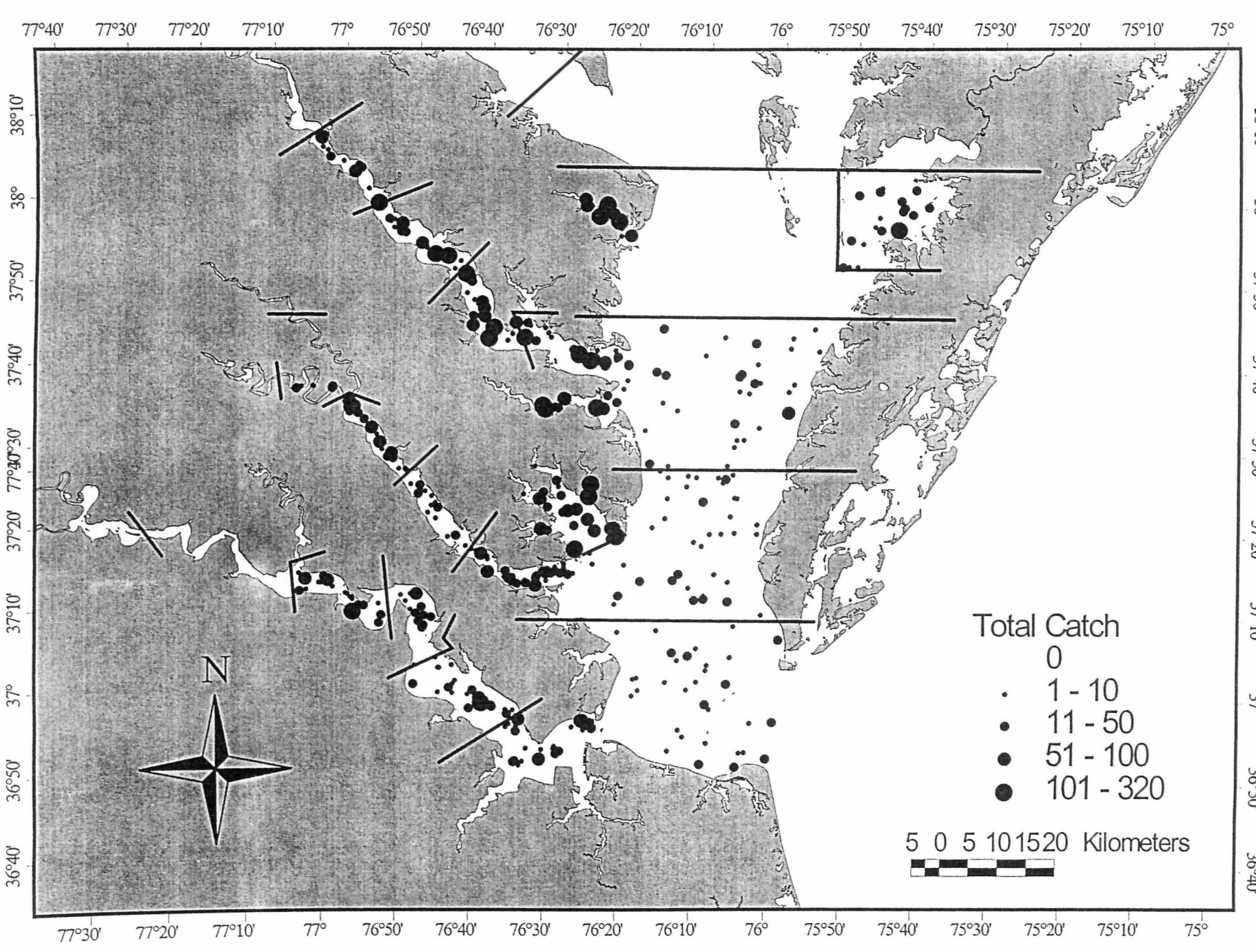

Spot
Atlantic Croaker
Weakfish
Summer Flounder
Weighted Geometric Mean per Trawl
50
40
30
20
10
0
160
120
80
40
0
8
6
4
2
0
3
2
1
0
Su98
Fa98
Wi99
Sp9
Season
CP
GW
MB
PK

Figure 25.

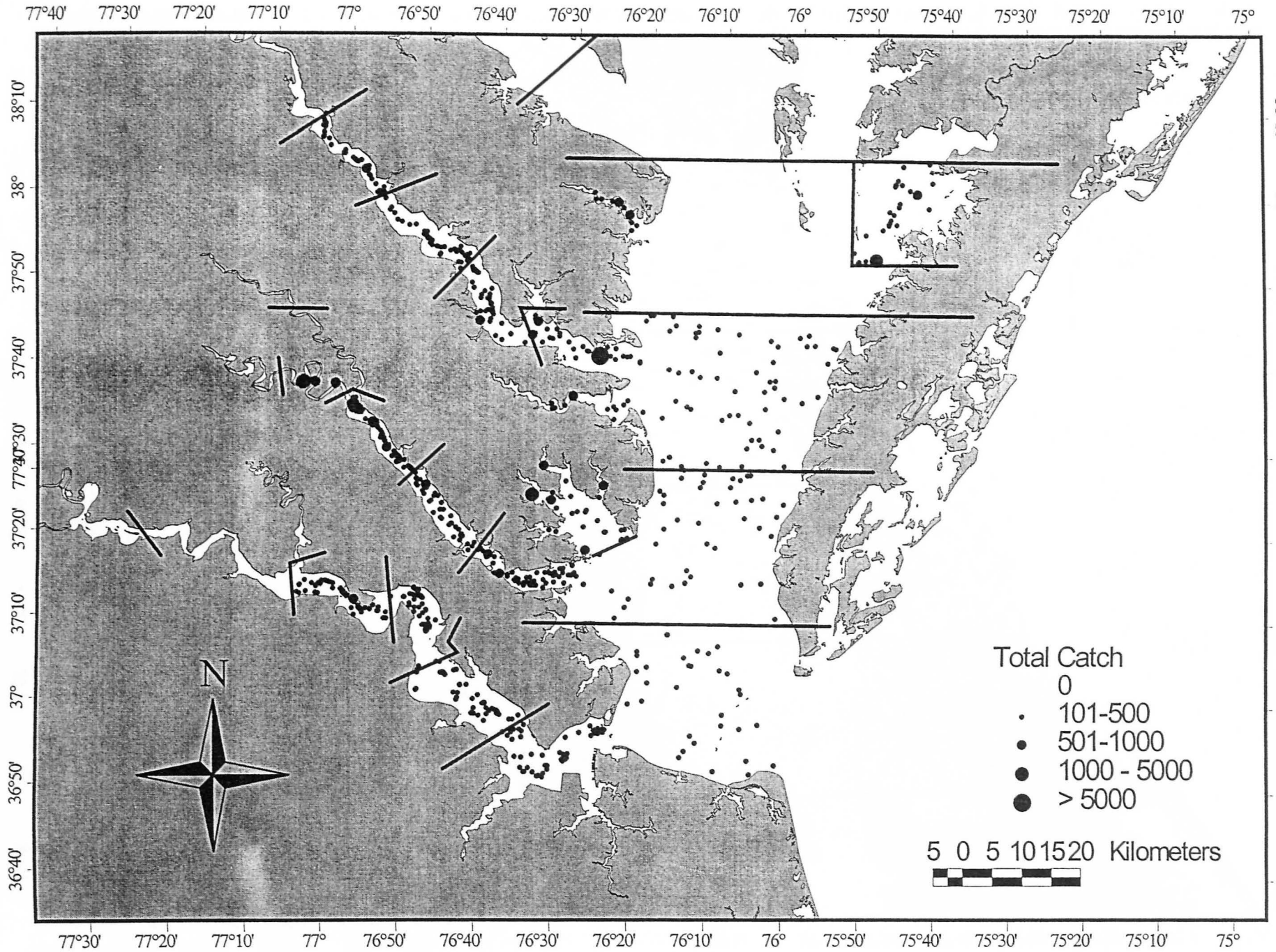
Appendix Figures 1-15. Trawl catches (numbers of index-aged individuals) plotted by month and station location for January 1998 to July 1999 for the following species:

Appendix Figure:

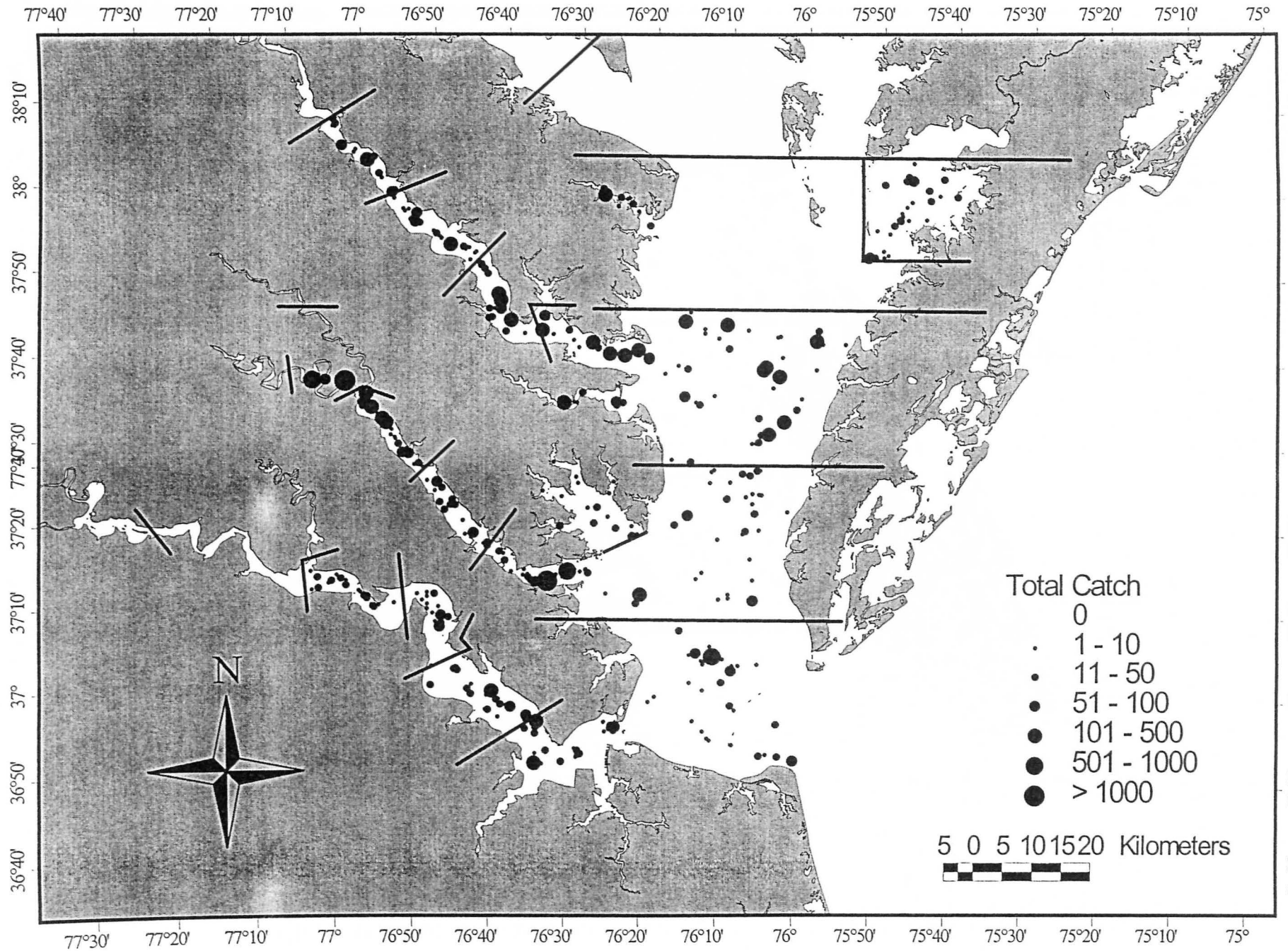
1. spot
2. Atlantic croaker
3. weakfish
4. summer flounder
5. black sea bass
6. early age-1 scup
7. y-o-y white perch
8. age 1+ white perch
9. striped bass
10. y-o-y white catfish
11. age 1+ white catfish
12. y-o-y channel catfish
13. age 1+ channel catfish
14. northern puffer
15. silver perch



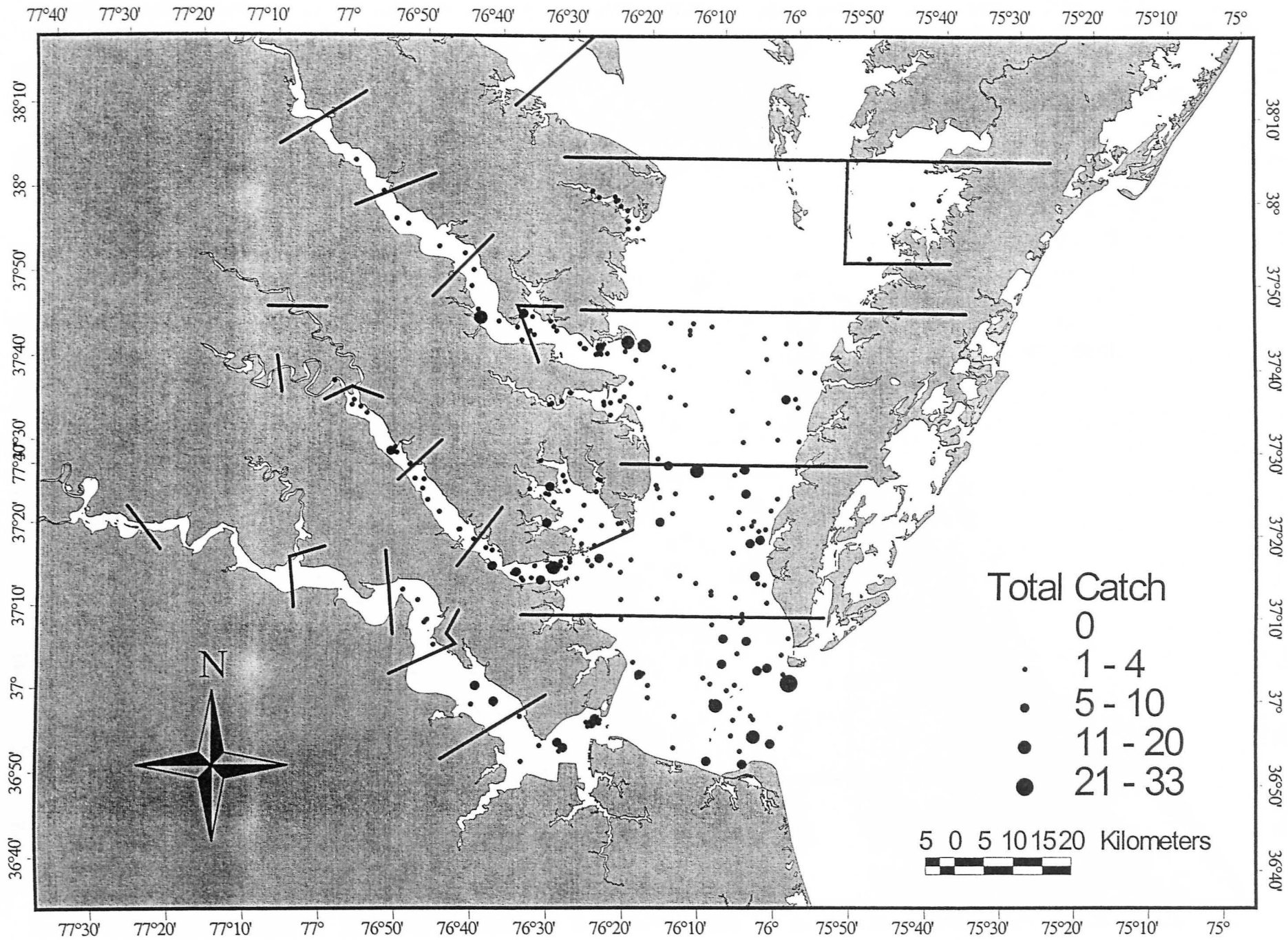
Appendix Figure 1. YOY spot from VIMS Trawl Survey January 1998 to July 1999.



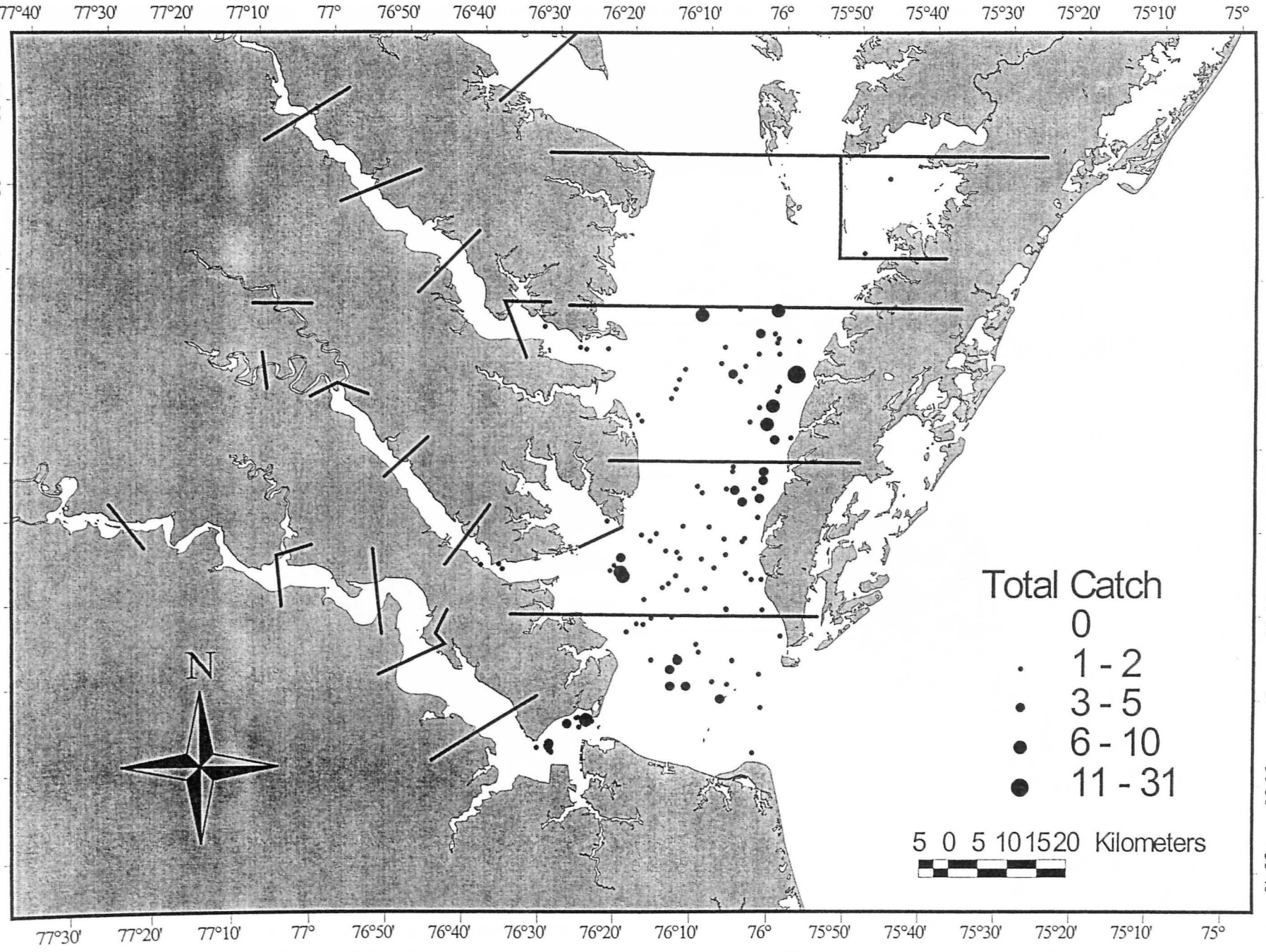
Appendix Figure 2. YOY Atlantic croaker from VIMS Trawl Survey January 1998 to July 1999.



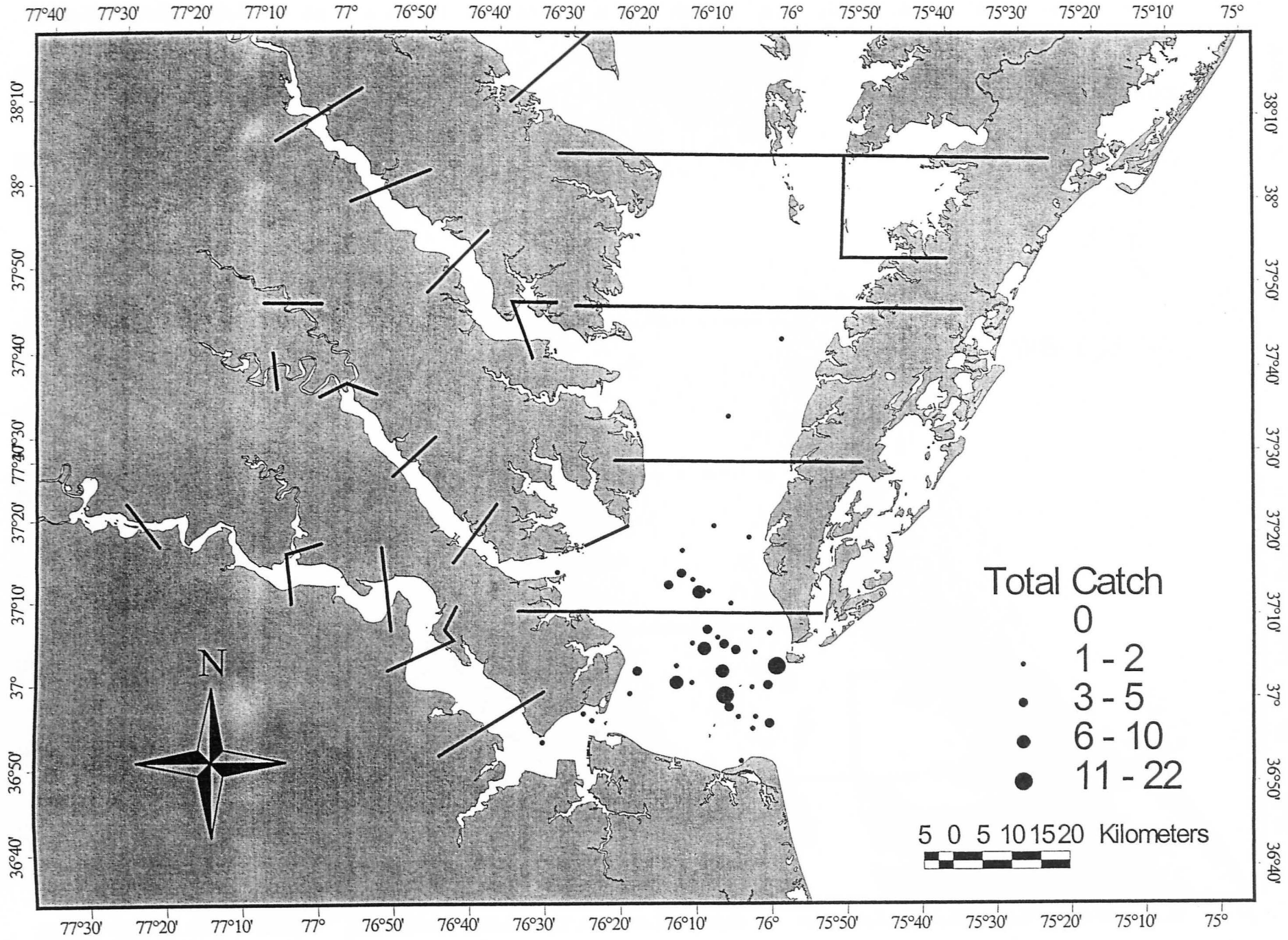
Appendix Figure 3. YOY weakfish from VIMS Trawl Survey January 1998 to July 1999.



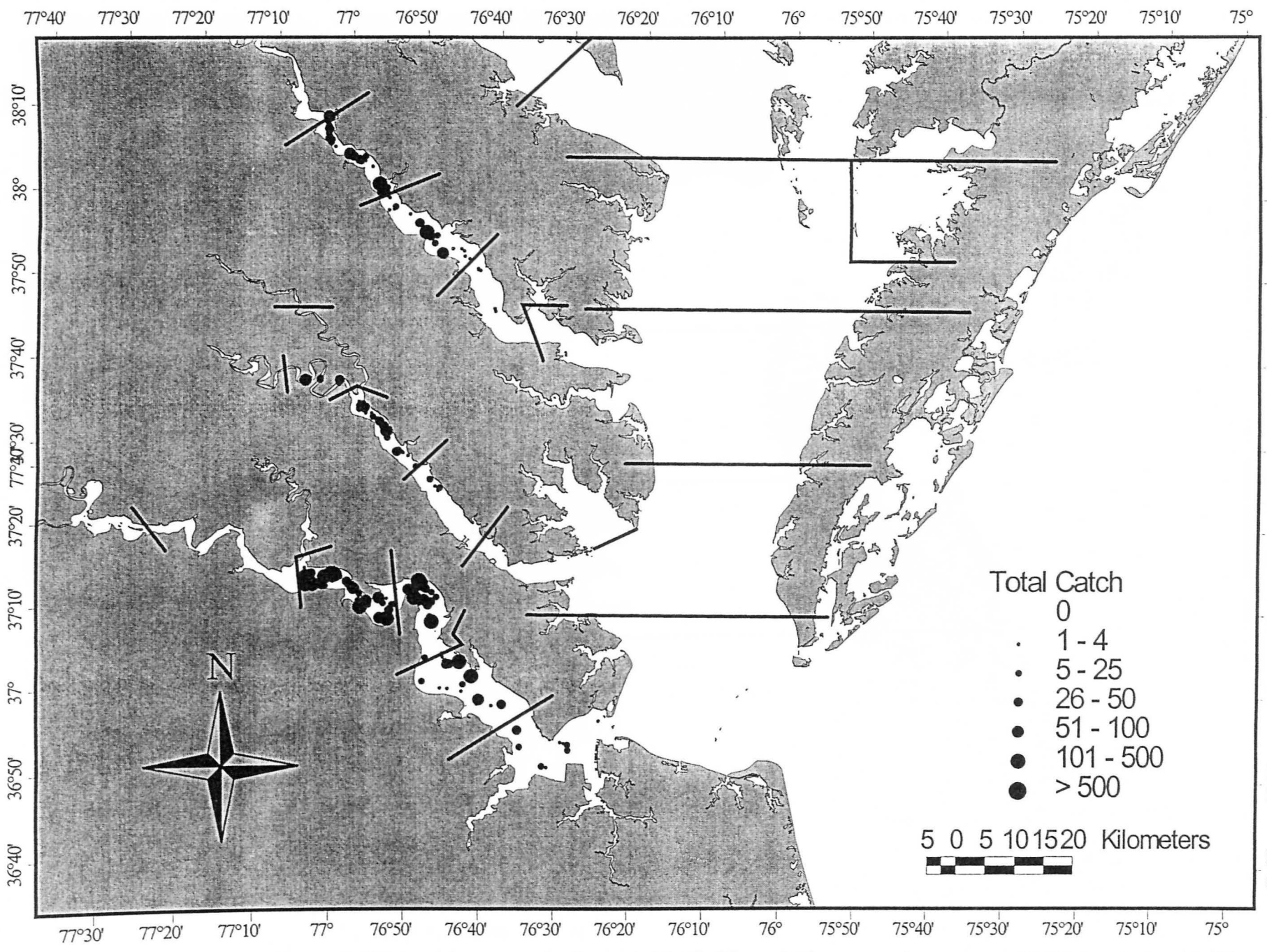
Appendix Figure 4. YOY summer flounder from VIMS Trawl Survey January 1998 to July 1999.



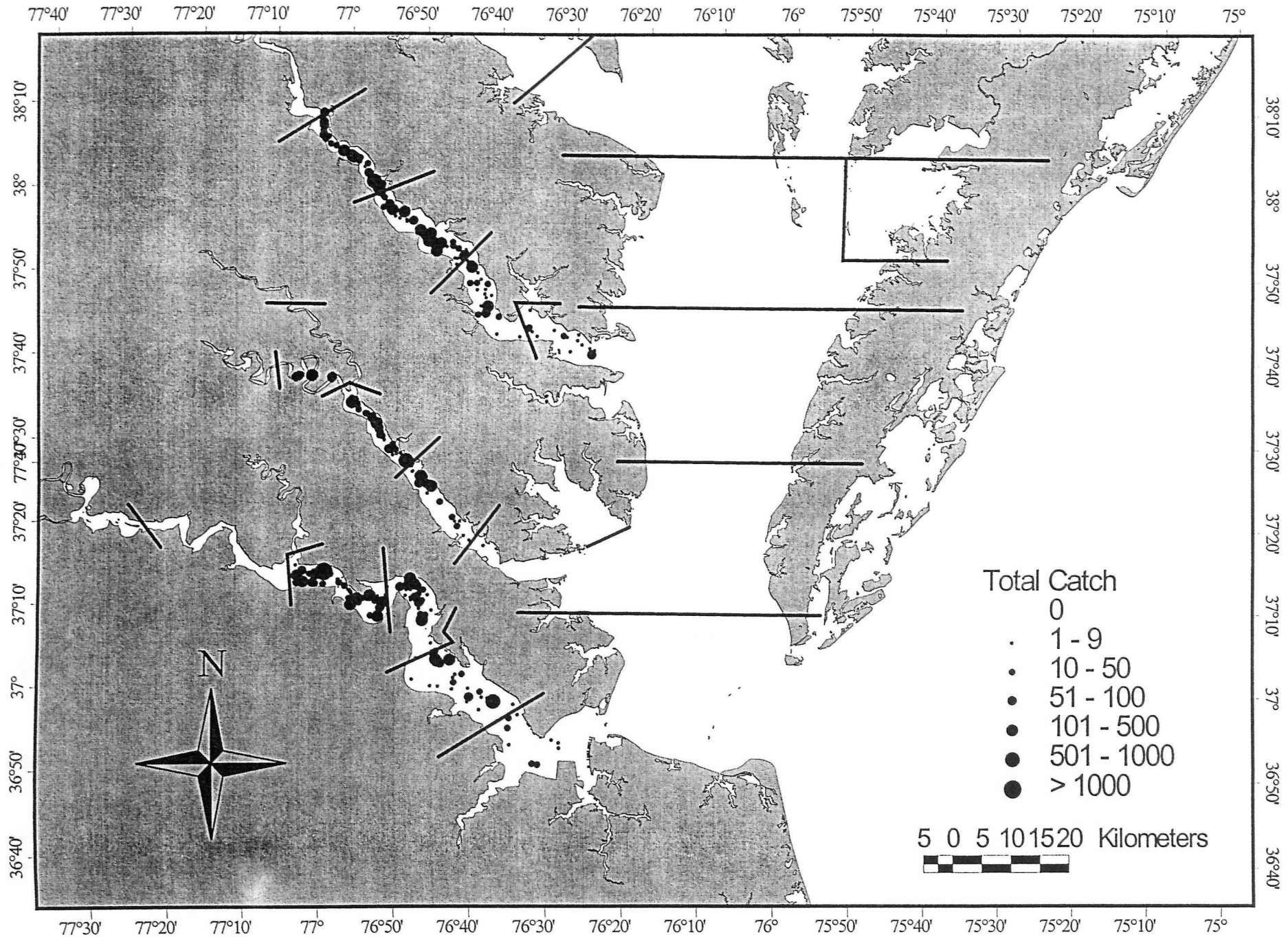
Appendix Figure 5. YOY black seabass from VIMS Trawl Survey January 1998 to July 1999.



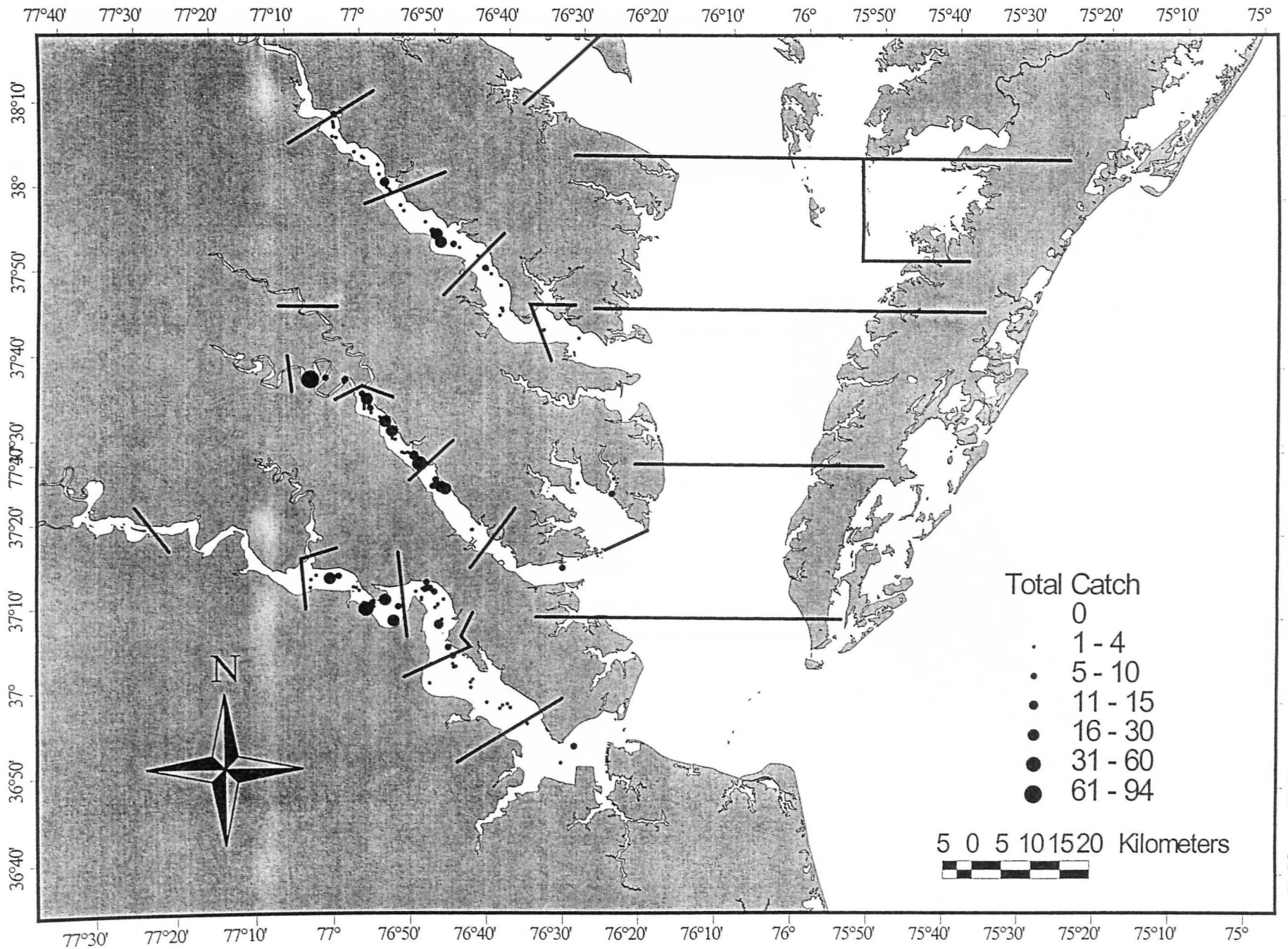
Appendix Figure 6. Age 1 scup from VIMS Trawl Survey January 1998 to July 1999.



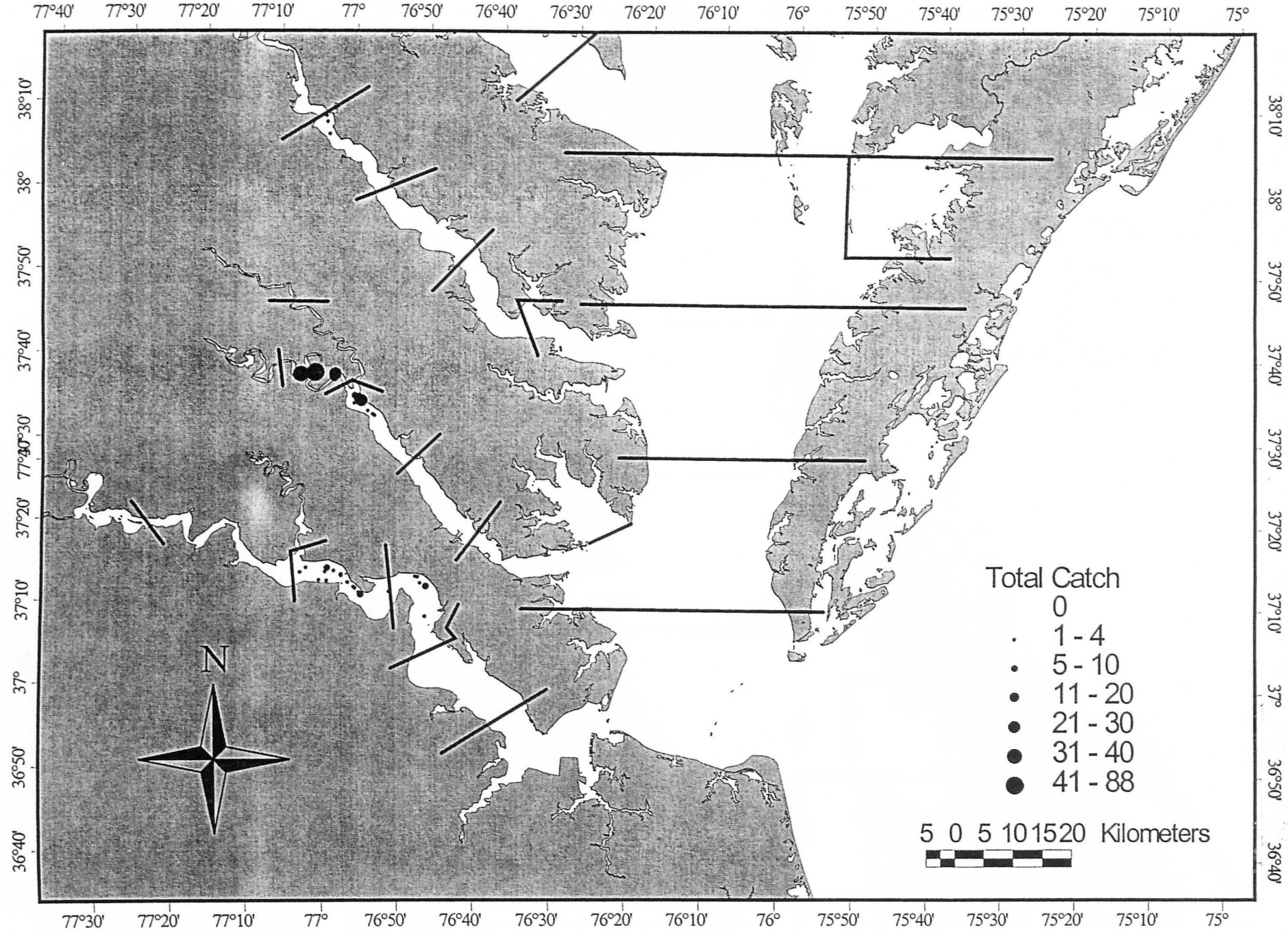
Appendix Figure 7. YOY white perch from VIMS Trawl Survey January 1998 to July 1999.



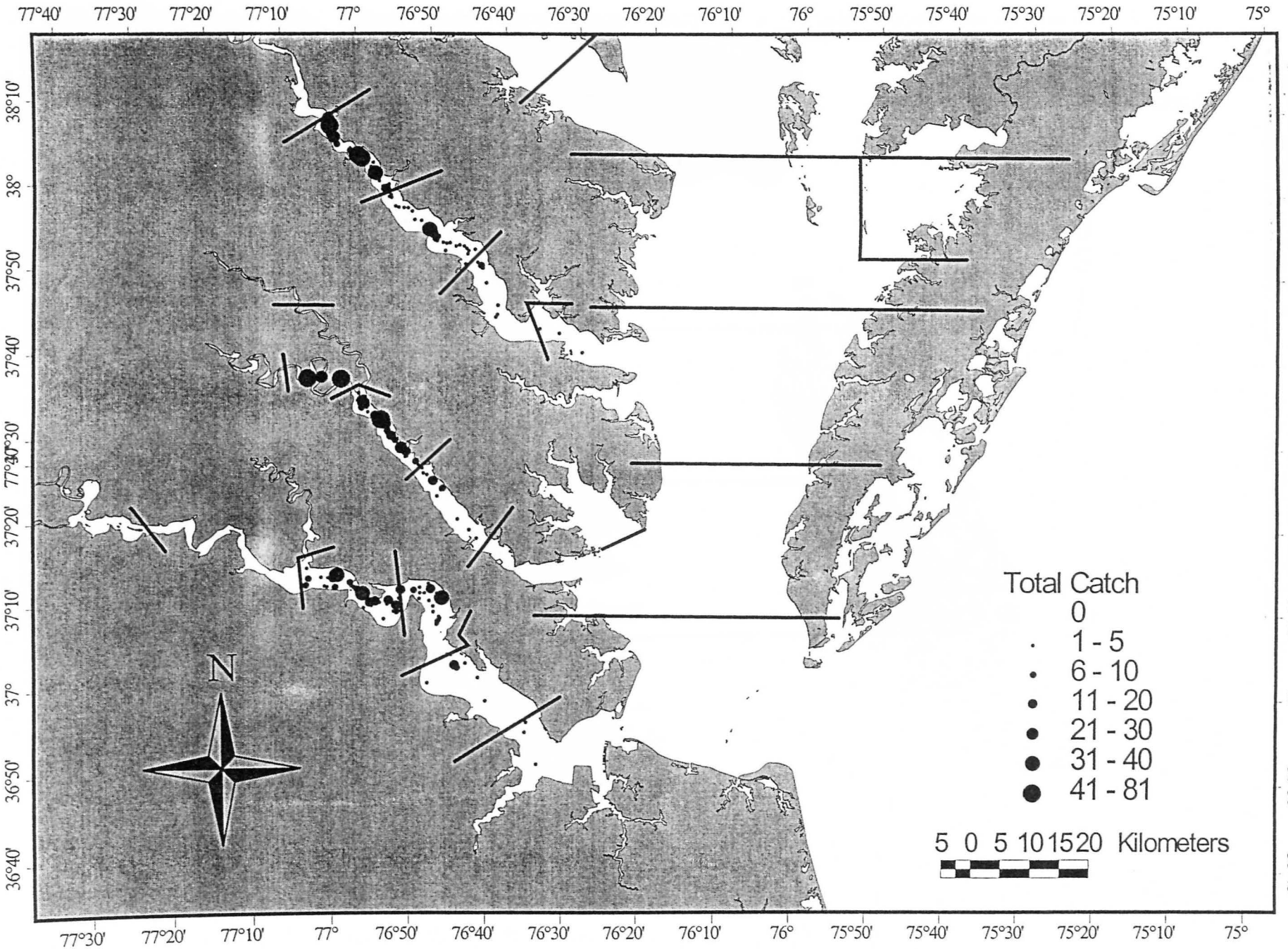
Appendix Figure 8. Age 1+ white perch from VIMS Trawl Survey January 1998 to July 1999.



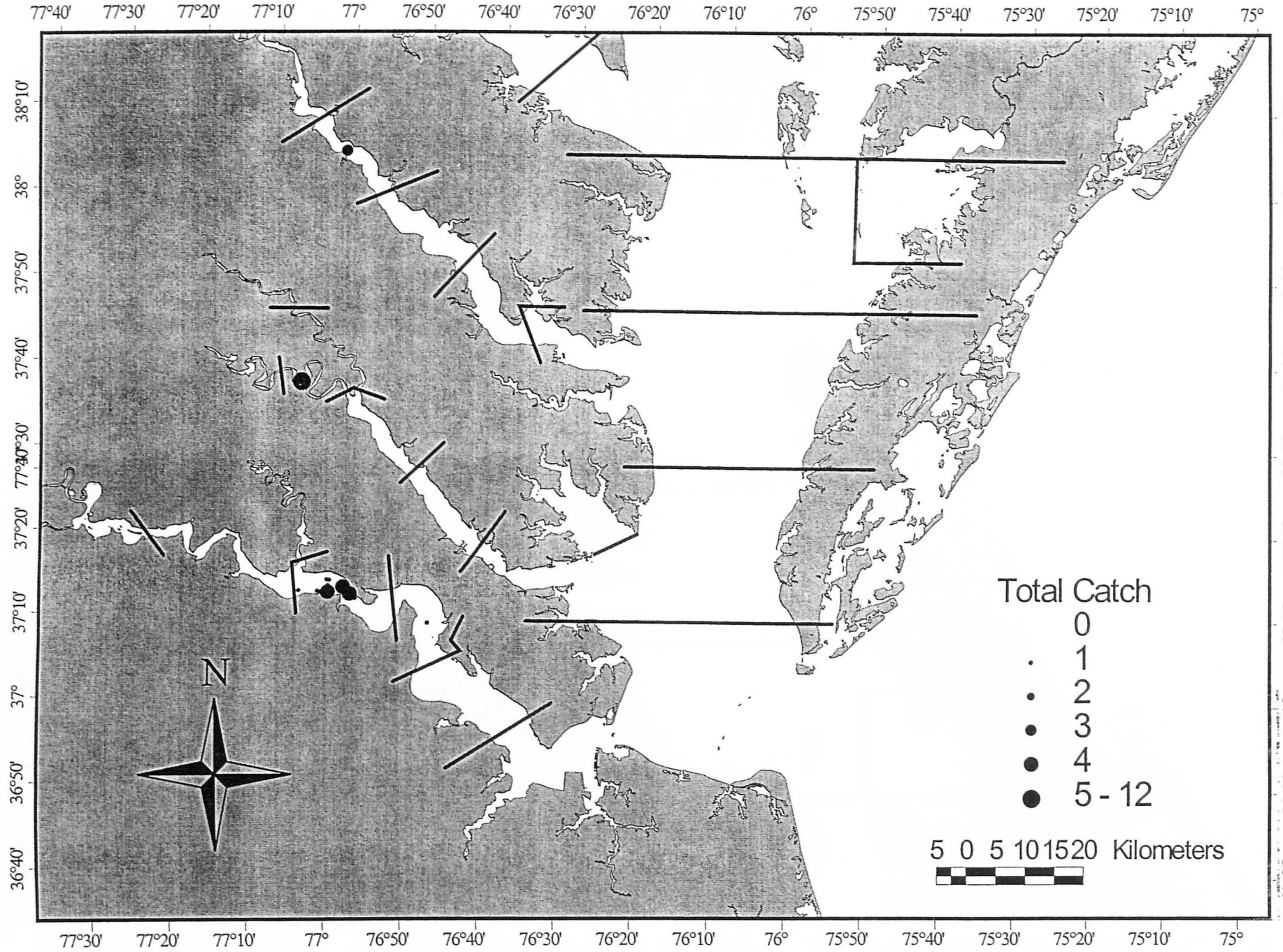
Appendix Figure 9. YOY striped bass from VIMS Trawl Survey January 1998 to July 1999.



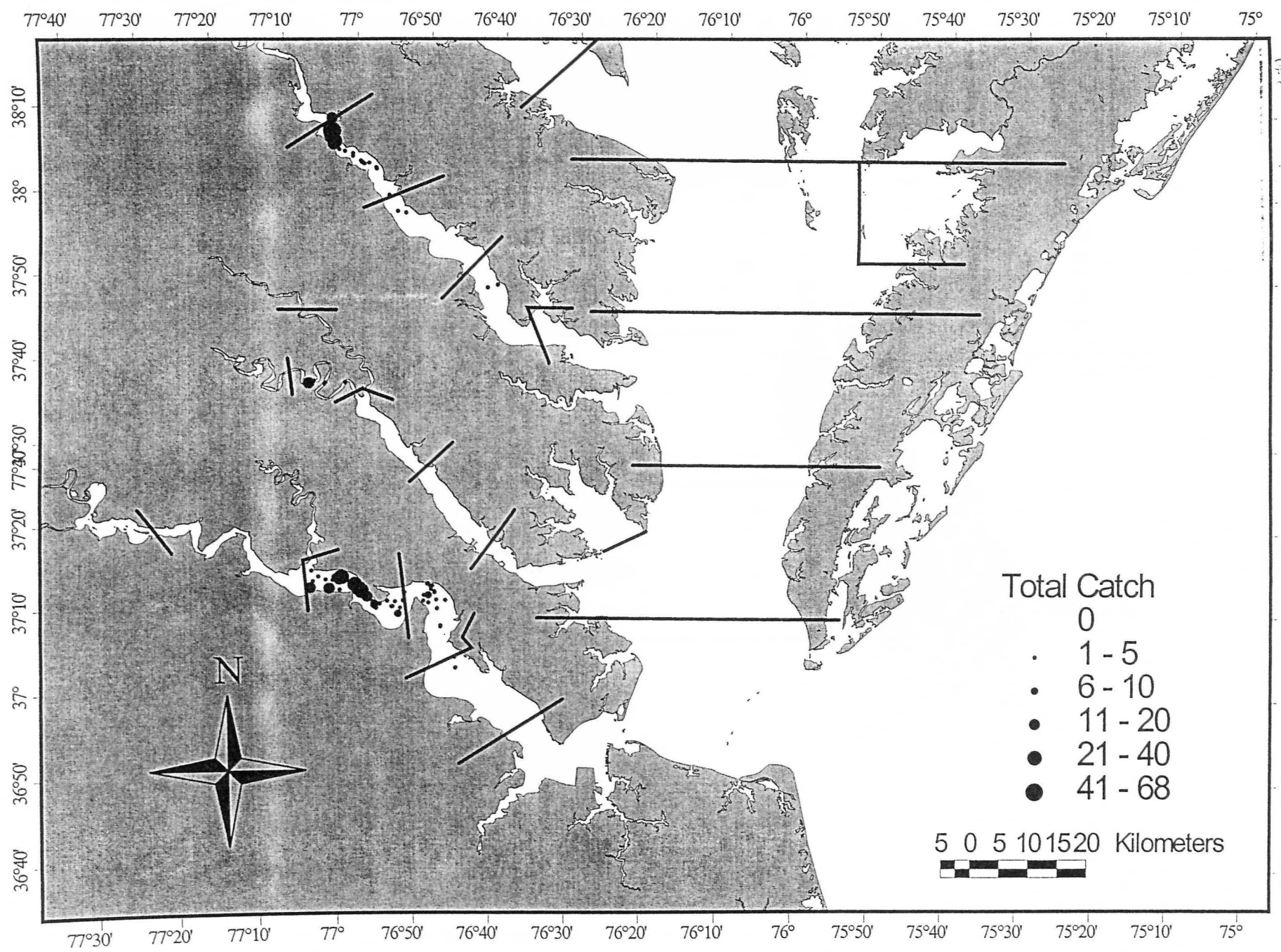
Appendix Figure 10. YOY white catfish from VIMS Trawl Survey January 1998 to July 1999.



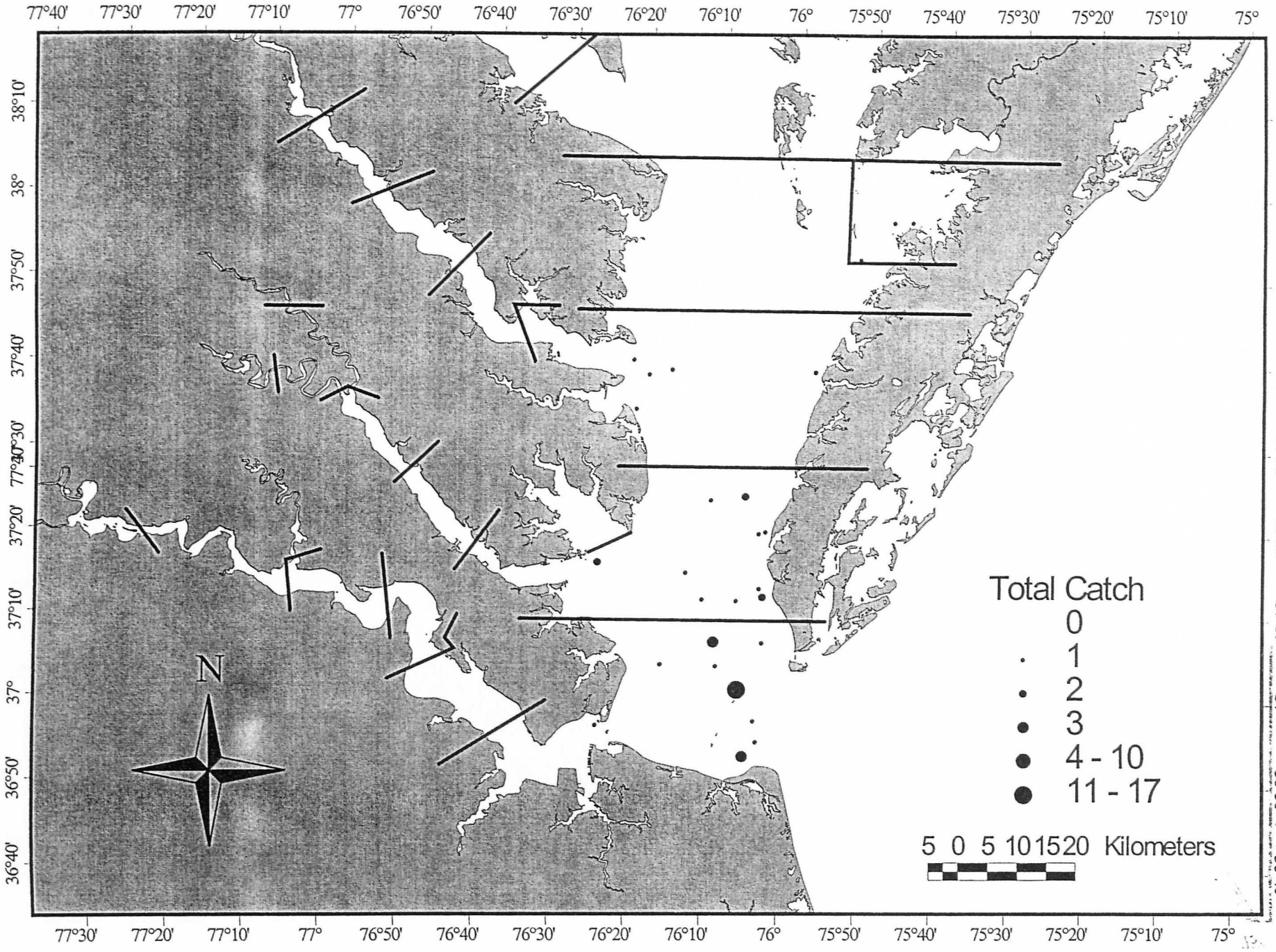
Appendix Figure 11. Age 1+ white catfish from VIMS Trawl Survey January 1998 to July 1999.



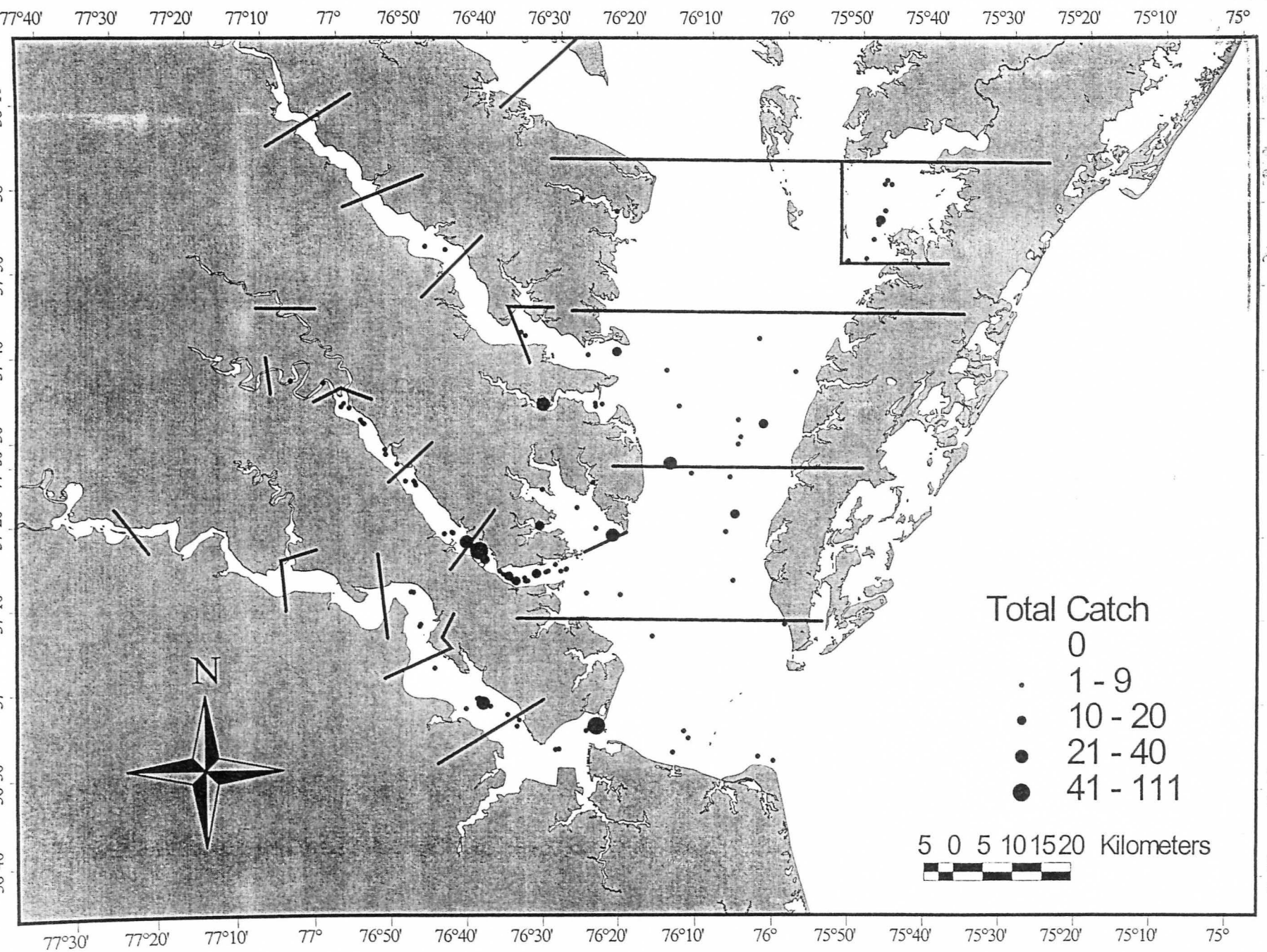
Appendix Figure 12 YOY channel catfish from VIMS Trawl Survey January 1998 to July 1999.



Appendix Figure 13. Age 1+ channel catfish from VIMS Trawl Survey January 1998 to July 1999.



Appendix Figure 14. YOY northern puffer from VIMS Trawl Survey January 1998 to July 1999.



Appendix Figure 15. YOY silver perch from VIMS Trawl Survey January 1998 to July 1999.